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St. Paul District

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WILDS BEND CHANNEL IMPROVEMENT
POOL 5A-MISSISSIPPI RIVER
FOUNTAIN CITY, WISCONSIN
ALTERNATIVES REPORT

FEBRUARY 1988

UNCLASSIFIED

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The study area is on the Wisconsin side of the Mississippi River, about 1 mile upstream of lock and dam 5A, near Winona, Minnesota. The present commercial navigation route is via Betsy Slough. The Wilds Bend area lies between Fountain City, Wisconsin, and dam 5A or the Mississippi River 9-foot channel project. The Mississippi River makes three shrap, treacherous bends before straightening out a mile upstream of the lock and dam. The river channel bends are difficult to navigate and require almost annual maintenance dredging.

The purpose of the study is to determine what needs to be done to decrease annual dredging requirements and improve navigation safety, while at the same time possibly enhancing area fish and wildlife potential or, at a minimum, mitigating any adverse effects from a proposed project.

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DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
1421 U.S. POST OFFICE & CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101-1479

FEBRUARY 1988

WILDS BEND CHANNEL IMPROVEMENT

POOL 5A - MISSISSIPPI RIVER

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WILDS BEND CHANNEL IMPROVEMENT

POOL 5A - MISSISSIPPI RIVER

AUTHORITY

The authority for this report is in the following legislation and House resolution:

- River and Harbor Act of July 3, 1930 (House Resolution 11781)

  "Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following works of improvement are hereby adopted and authorized, to be prosecuted under the direction of the Secretary of War and supervision of the Chief of Engineers, in accordance with the plans recommended in the reports hereinafter designated. . . ."

  "Mississippi River between mouth of Illinois River and Minneapolis: The existing project is hereby modified so as to provide a channel depth of nine feet at low water with widths suitable for long-haul common-carrier service, to be prosecuted in accordance with the plan for a comprehensive project to procure a channel of nine-foot depth, submitted in House Document Numbered 290, Seventy-first Congress, second session; . . ."

- River and Harbor Act of February 24, 1932 (House Joint Resolution 271)

  "Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the provision, relating to the Mississippi River between the mouth of the Illinois River and Minneapolis, in section 1 of the Act entitled 'An Act authorizing the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes,' approved July 3, 1930, is hereby amended to read as follows:

  'Mississippi River between mouth of Illinois River and Minneapolis: The existing project is hereby rodified so as to provide a channel depth of nine feet at low water with widths suitable for long-haul common-carrier service, to be prosecuted in accordance with the plan for a comprehensive project to procure a channel of nine-foot depth, submitted in House Document Numbered 290, Seventy-first Congress, second session, or such modification thereof as in the discretion of the Chief of Engineers may be advisable; . . .' "

o River and Harbor Act of August 30, 1935 (House Resolution 6732)

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following works of improvement of rivers, harbors, and other waterways are hereby adopted and authorized, to be prosecuted under the direction of the Secretary of War and supervision of the Chief of Engineers, in accordance with the plans recommended in the respective reports hereinafter designated and subject to the conditions set forth in such documents; and that hereafter Federal investigations and improvements of rivers, harbors, and other waterways shall be under the jurisdiction of and shall be prosecuted by the War Department under the direction of the Secretary of War and the supervision of the Chief of Engineers, except as otherwise specifically provided by Act of Congress:..."

"Mississippi River between Missouri River and Minneapolis; House Document Numbered 137, Seventy-second Congress, and Rivers and Harbors Committee Document Numbered 44, Seventy-fourth Congress; . . ."

o Resolution of House Committee on Flood Control, September 18, 1944

"Resolved, by the Committee on Flood Control, House of Representatives, That the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report on the Mississippi River between Coon Rapids Dam, Minnesota, and the mouth of the Ohio River, submitted in House Document No. 669, Seventy-sixth Congress, third session, with a view to determining the advisability of providing flood protection along the Mississippi River above the mouth of the Missouri River."

STUDY PURPOSE AND SCOPE

The purpose of the study is to determine what needs to be done to decrease annual dredging requirements and improve navigation safety, while at the same time possibly enhancing area fish and wildlife potential or, at a minimum, mitigating any adverse effects from a proposed project improvement.

The study is of feasibility scope. A reconnaissance report completed in October 1985 found there were several economically viable alternatives to the existing situation. This alternatives report is designed to evaluate more thoroughly the reconnaissance report alternatives and, with the aid of public involvement, arrive at a recommended plan of improvement.

LOCATION AND DESCRIPTION

The study area is on the Wisconsin side of the Mississippi River, about 1 mile upstream of lock and dam 5A, near Winona, Minnesota, between river miles 729 and 732.0 above the mouth of the Ohio River. The present commercial navigation route is via Betsy Slough. (See the following figure.)

The Wilds Bend area lies between Fountain City, Wisconsin, and lock and dam 5A of the Mississippi River 9-foot navigation channel project. The Mississippi River makes three sharp, treacherous bends before straightening out a mile upstream of the lock and dam. The river channel bends are difficult to navigate and require almost annual maintenance dredging.

The present channel bend at mile 729.5 puts a downbound tow on the opposite side of the river from the approach to lock and dam 5A, at mile 728.5[1]. At that point, tows have only 1 mile to cross the river and line up with the lock. If an upbound tow coming out of the lock were to encounter a downbound tow in this reach, they would have a high probability of collision. A collision would likely scuttle barges onto lock and dam 5A. Therefore, downbound tows wait along the left bank until upbound tows pass. Also, the use of radios and communication between pilots today makes the probability of collision extremely low.

The three bends are especially difficult to navigate at high water conditions.

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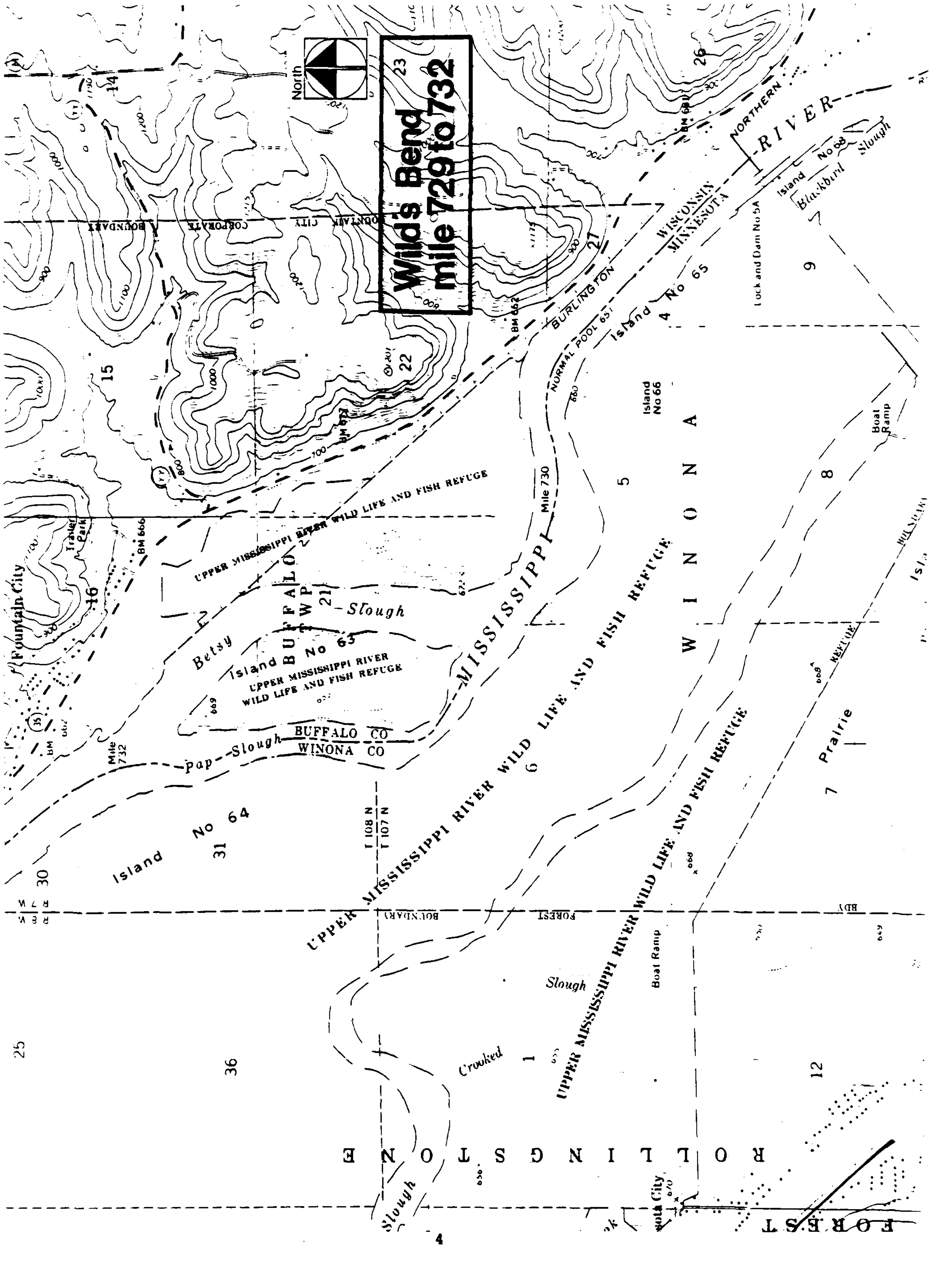
(1) Upper Mississippi River miles are measured above the mouth of the Ohio River, at Cairo, Illinois.


Wild's Bend
mile 729 to 732
North
Fountain City
Trailer Park
UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE
MISSISSIPPI
RIVER
WINONA
BUFFALO TWP 21
Betsy Slough
Island No 63
Pap Slough
BUFFALO CO
WINONA CO
Island No 64
Island No 65
Island No 66
Island No 68
Blackbird Slough
Lock and Dam No 5A
WISCONSIN
MINNESOTA
BURLINGTON NORTHERN
NORMAL POOL 651
Mile 730
Mile 732
Crooked Slough
Boat Ramp
Prairie
ROLLINGSTONE
FOREST
CITY CORPORATE BOUNDARY
T 108 N
T 107 N
R 7 W
R 8 W

HISTORY OF THE PROBLEM

This area has long been a problem for navigation interests and for the Corps of Engineers, which must dredge the bends almost annually to maintain the 9-foot channel. Requests that the Corps investigate these problems date back to 1937.

In the 1950's and 1960's, as tows became larger, the bigger tows had to be broken up into several sections. The remaining barges were moved above the cutoffs while the towboat took one section of the barges through the bends and lock. This procedure caused river traffic delays and was objectionable to navigation interests such as the Mississippi Valley Association, Upper Mississippi Waterways Association, American Waterways Operators, transportation companies, and vessel operators. Resolution of the problem has been advocated for a number of years (see appendix A).

The advent of higher-powered boats and more frequent maintenance dredging seems to have eliminated the need to break up tows. However, considerable delays are still a daily occurrence in the Wilds Bend area. Upbound tows often wait up to 1-1/2 hours at mile 729 to allow downbound tows to safely negotiate the Wilds Bend area. Individual delays vary from 45 minutes to 1 hour and 45 minutes. Sometimes two upbound tows tie off and wait for downbound tows in this area at the same time.

During high water especially, the flows down Betsy Slough are oriented toward the west end of the dam (overflow spillway) as they pass mile 730.5. These flows cause a noticeable "pileup" at the overflow spillway, before reversing and traveling east and south to pass through the gated dam section. Differences in pool levels of up to 1.75 feet occur between the west and east ends of dam 5A during high water because of this condition. This difference in elevation in Polander Lake does not appear to add to the navigation problems of Betsy Slough. In fact, the circular flow pattern benefits fishermen in Polander Lake.

A straight channel alignment, parallel to the railroad tracks on the Wisconsin side of the river, could reduce this "pileup" by directing more river flow toward the east end of the dam.

The Wilds Bend area is one of the worst areas within the St. Paul District in terms of accidents and spills. Two major barge spills occurred in this area, both in May 1978, one involving 120,000 gallons of jet fuel and the other involving 1,000 gallons of crude oil. The potential for environmental impacts is quite significant because Betsy Slough flow is oriented into the Polander Lake area. If a barge carrying ammonia products were to run aground and rupture, for example, the potential results to fish, wildlife, and the human environment could be disastrous.

The record of reported towboat groundings in the District office files in not complete, but is more comprehensive for the last 8 years (1981-1987). Examination of these records shows one to six <u>reported</u> groundings in any particular year in the Wilds Bend area. Time delays varied from 15 minutes to 15 hours for these reported groundings.

Additional incident information dating back to 1970 was obtained from the U.S. Coast Guard records in Washington, D.C. These records were combined with District office file information to obtain a more complete record of the problems tows experience in the river mile 729 to 732 reach of the Mississippi River.

One interesting observation extracted from the Coast Guard records was the fact that the Coast Guard data lists a category titled "Collision" or "Meeting Situation." The Coast Guard data show three such events occurring in 1977 and 1979 in the Wilds Bend area (two in 1977 and one in 1979).

It is also evident from these records, and from discussions with personnel familiar with the area, that many groundings go unreported. Pilots appear reluctant to report these incidents.

An outdraft problem exists for downbound tows in the 1-mile channel segment upstream of lock and dam 5A. This outdraft tends to direct downbound tows toward the east end of lock and dam 5A, pulling the tows away from the locks. An extension of the existing upper guidewall has been proposed to relieve the outdraft situation. Elimination of the several channel bends upstream of mile 729.5 could aid the efforts of downbound tows to line up with the lock on the west end of the dam 5A gated section.

PRIOR INVESTIGATIONS

GENERAL

Cost estimates were developed for a channel cutoff in the Wilds Bend area at least twice, in 1937 and 1955. That project apparently was never completed because of either a lack of funds or a firm plan to resolve the problem.

The Corps of Engineers most recently presented the Wilds Bend navigation problem to the Channel Maintenance Forum for possible solution on November 29, 1984. The St. Paul District Construction-Operations Division had received many requests from navigation interests concerning this matter, dating back to 1937. The Channel Maintenance Forum endorsed the previously mentioned reconnaissance study of the problem area and the reconnaissance study was initiated by the District's Planning Division based on an April 16, 1985, request for the study by the St. Paul District Construction-Operations Division.

RECONNAISSANCE STUDY

The reconnaissance study of the area was completed in October 1985. This study evaluated six alternatives which are summarized in the two tables that follow. Land ownership and the alternatives evaluated are shown on the figures that follow the tables.

Plan Comparison from Reconnaissance Study

Alternative	Annual Benefits	Annual Costs	Benefit-Cost Ratio
1. Do Nothing	$ 140,000(1)	$140,000	1.0
2. Channel Cutoff	1,310,000	597,000	2.19
2A. Channel Cutoff	1,100,000	524,000	2.10
3. Restore Pap Slough	913,000	774,000	1.18
4. Betsy Slough Overdredging	150,000(1)	327,000	<1.0
5. Training Structures in Betsy Slough	100,000	52,400	1.91
6. Revised Operating Plan	0	0	-

(1) Annual benefits are assumed equal to current annual costs.

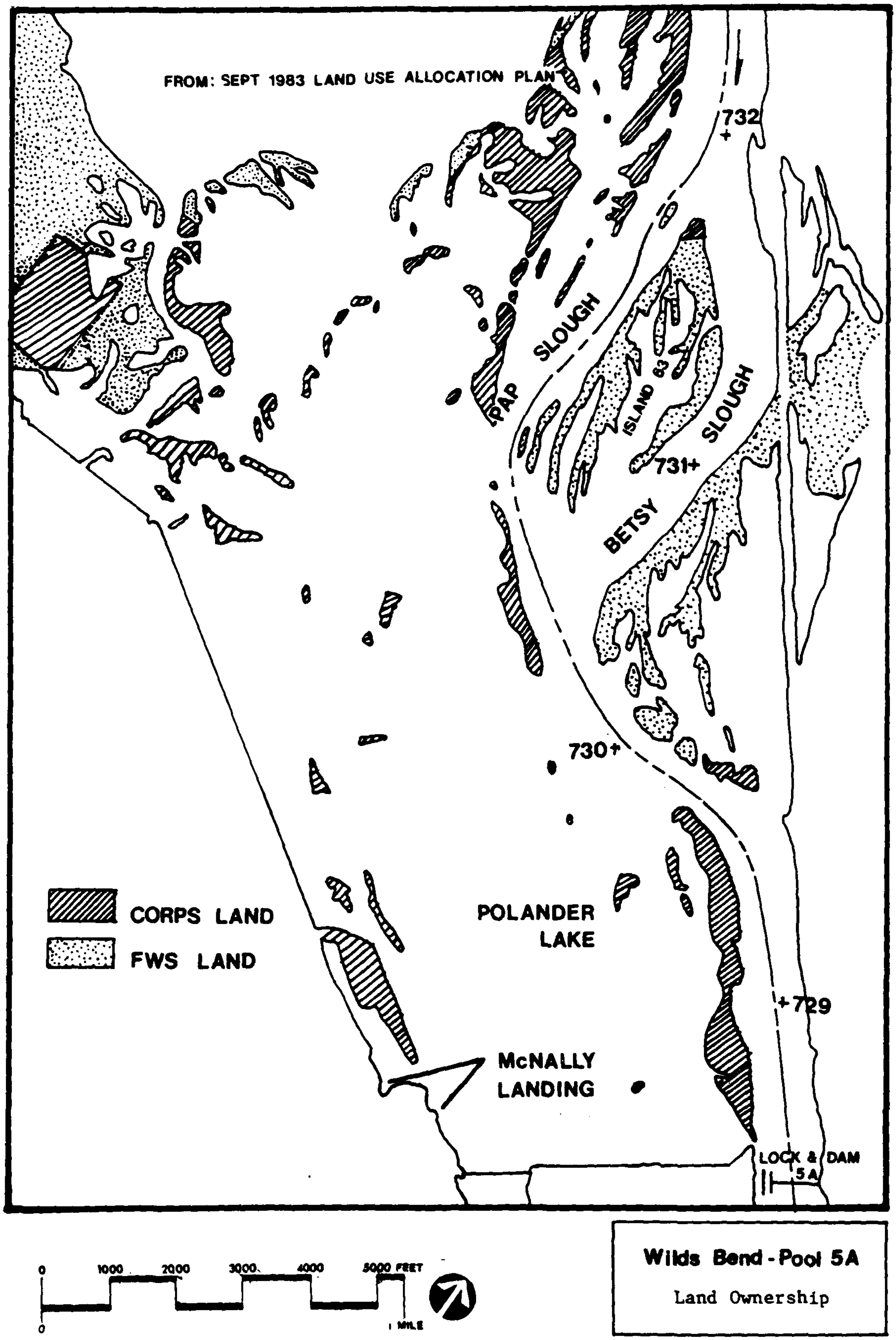
Figures are in October 1984 price levels, interest rate at 8 3/8-percent, and 100-year life (interest and amortization factor = 0.08378).

Benefits and Costs, Wilds Bend, from Reconnaissance Study

Alternative	Costs				Annual Benefits			
	First Cost Construction	Annual Cost Construction	Dredging Costs (Annual Maintenance)	Total Annual Costs	Decrease in Dredging Costs	Transportation Savings	Increase in Recre. Benefits	Increase in Wildlife Benefits
1. Do Nothing	0	0	$140,000	$140,000	0	0	0	0
2. Channel Cutoff(1)	$5,460,000	$457,000	140,000	597,000	0	$1,310,000		
2A. Channel Cutoff(1)	4,587,000	384,000	140,000	524,000	0	1,100,000		
3. Restore Pap Slough	7,563,000	634,000	140,000	774,000	0	913,000		
4. Betsy Slough Overdredging	2,115,000	177,000	150,000	327,000	-10,000	0	0	0
5. Training Structures in Betsy Slough	148,000	12,400	40,000	52,400	100,000	0	0	0
6. Revised Operating Plan	0	0	0	0	0	0	?	?

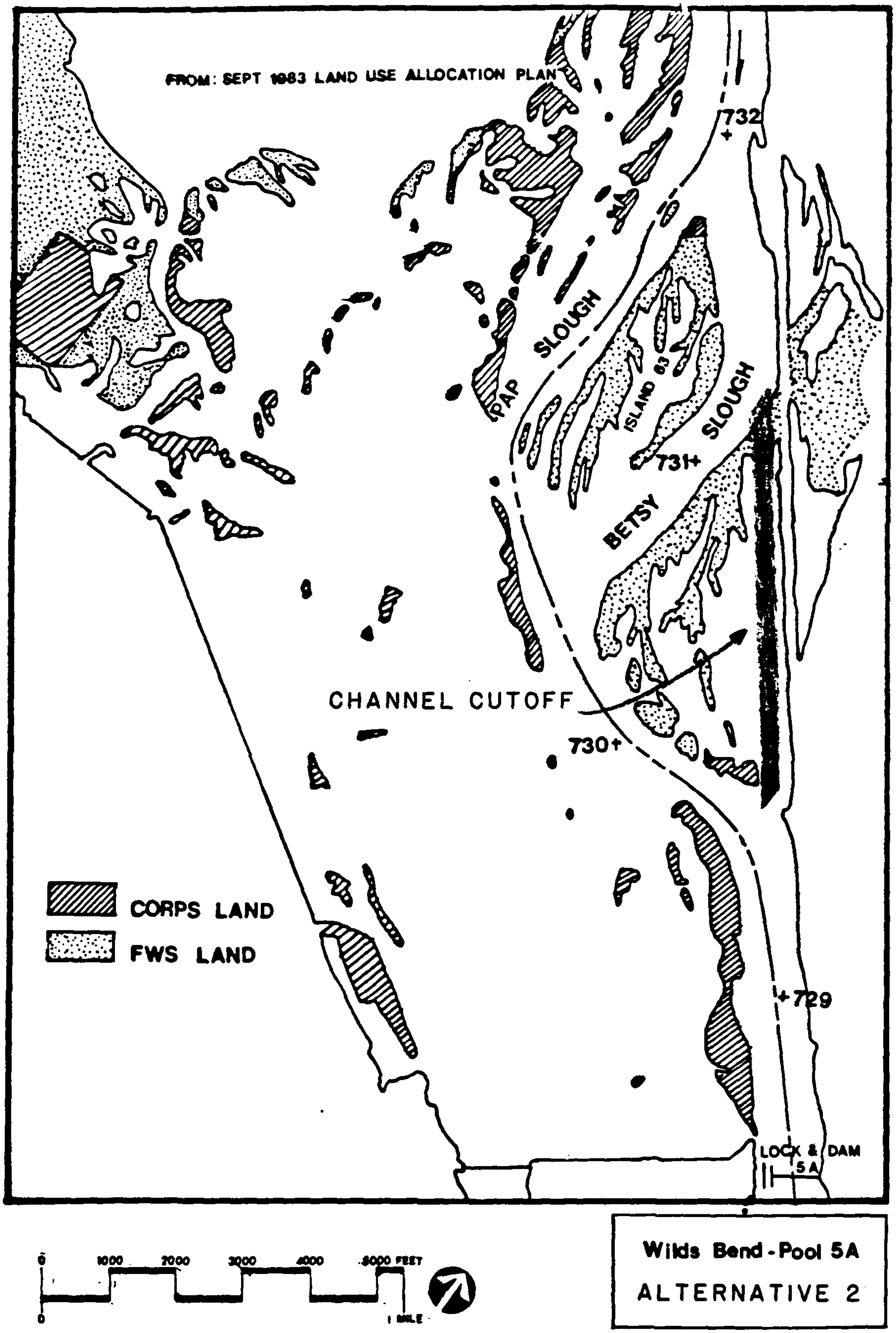
(1) Assumes no riprap on new channel.

Figures are in October 1984 price levels, interest rate at 8 3/8-percent, and 100-year life (interest and amortization factor = 0.08378).

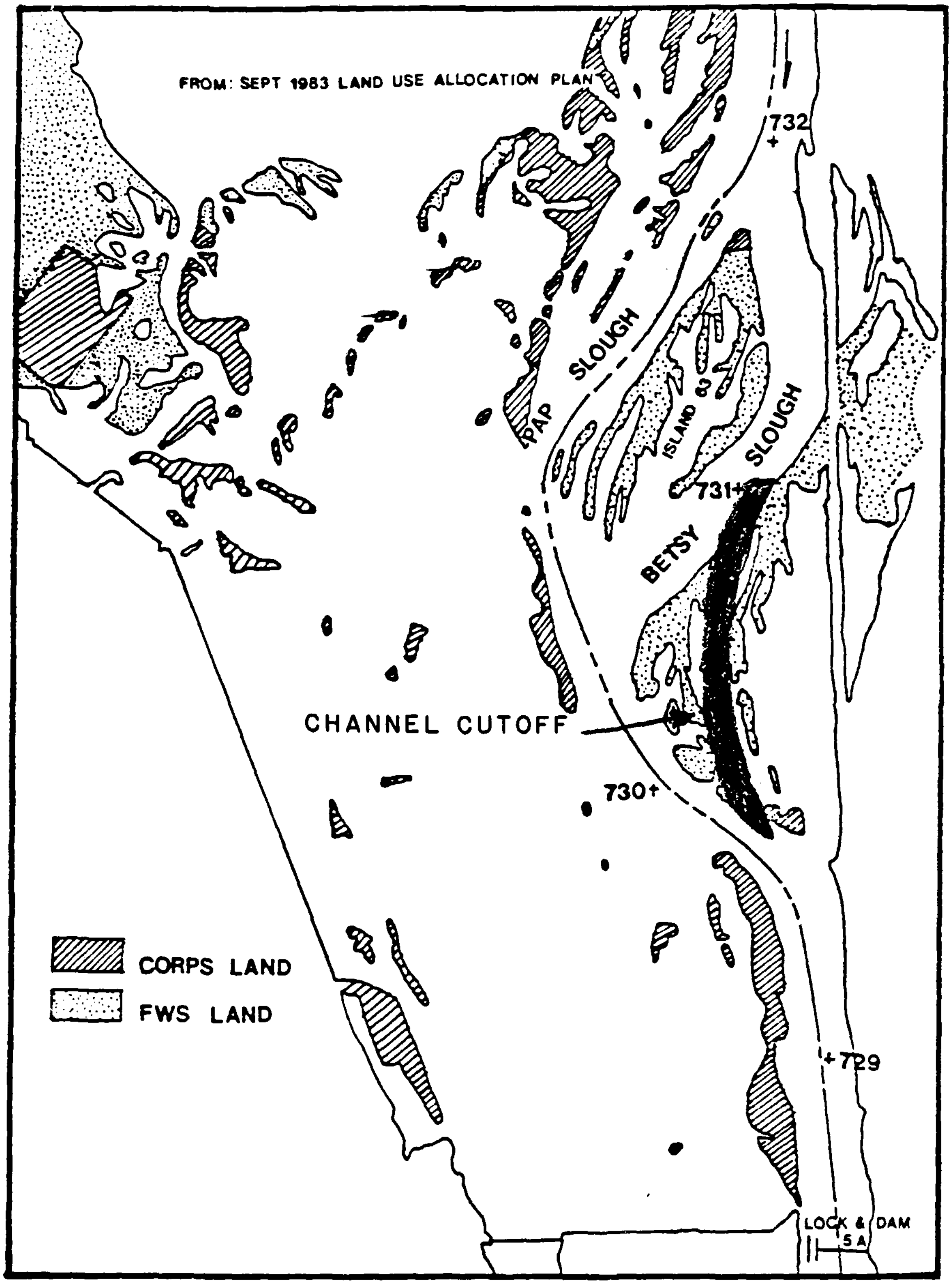


Wilds Bend - Pool 5A

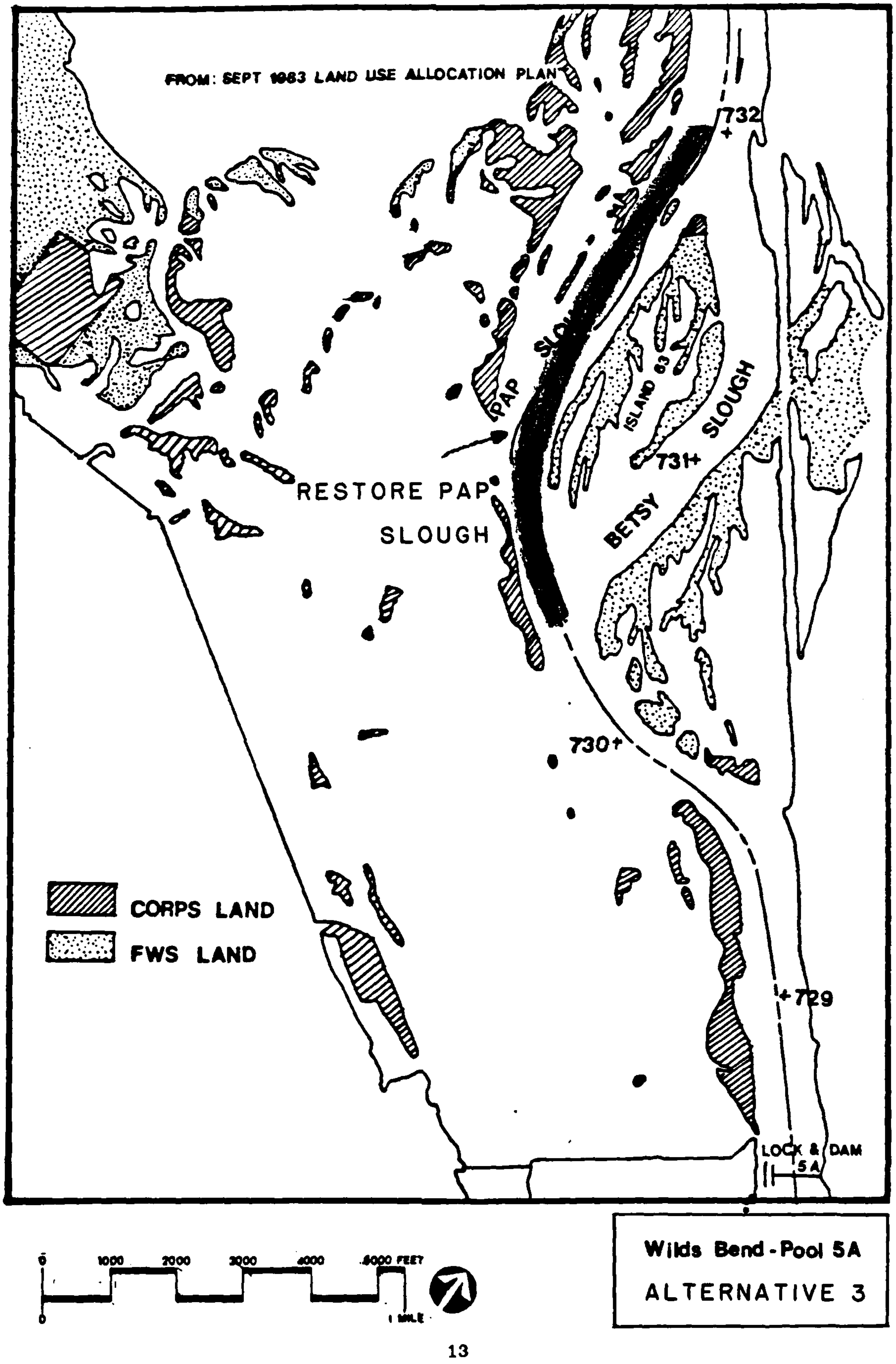
Land Ownership



Wilds Bend - Pool 5A
ALTERNATIVE 2

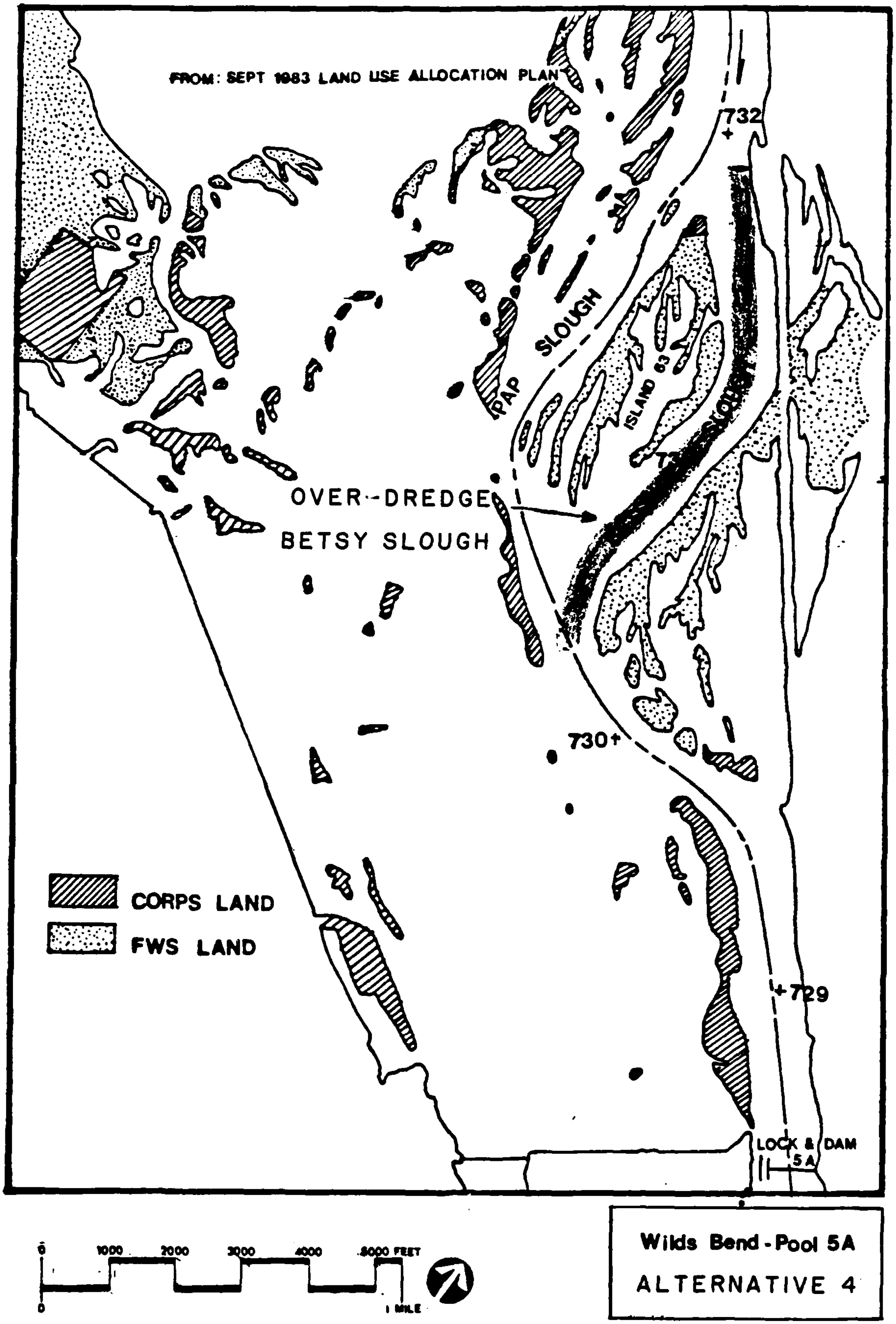


Wilds Bend - Pool 5A
ALTERNATIVE 2A

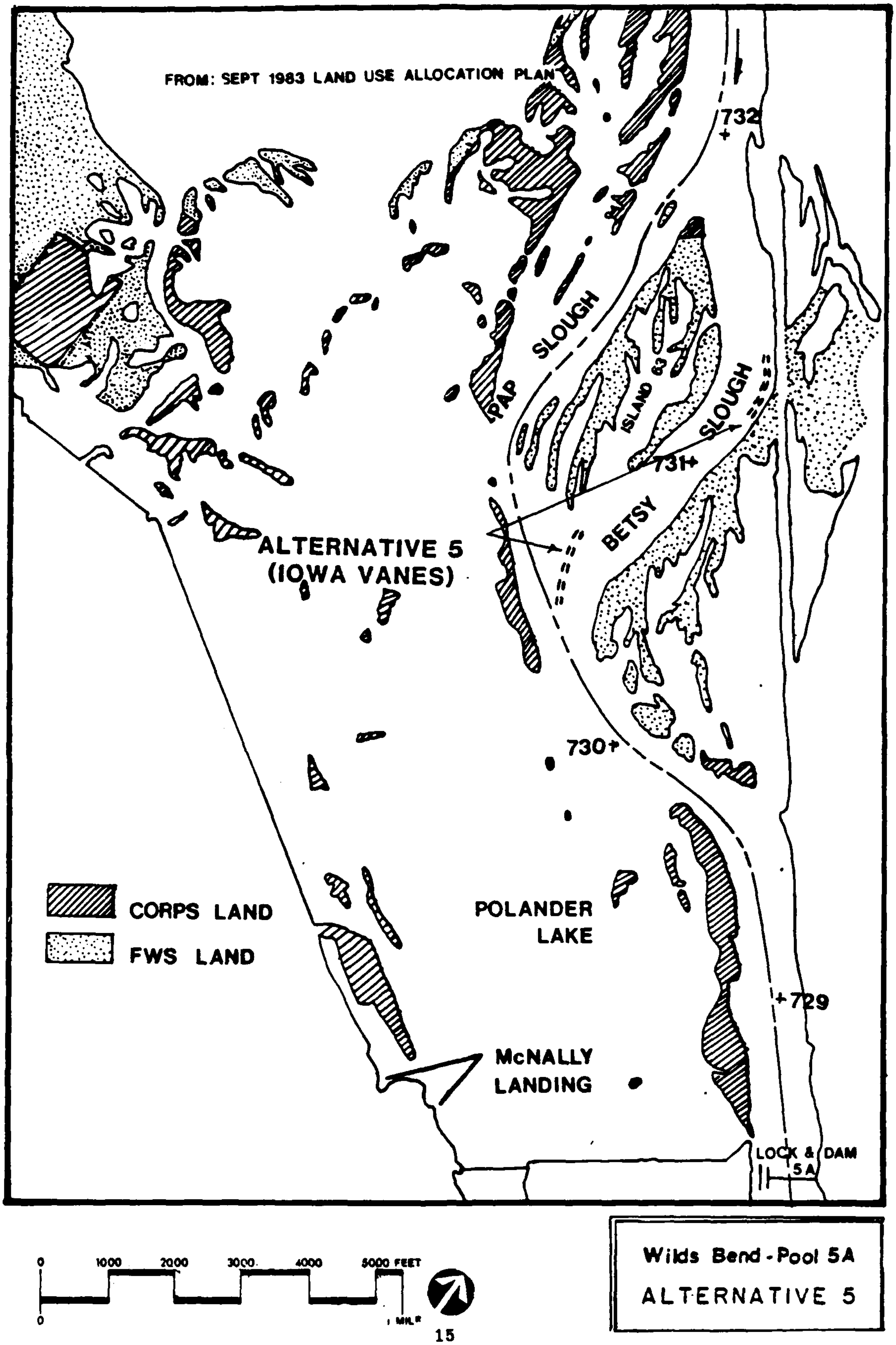


Wilds Bend - Pool 5A

ALTERNATIVE 3



Wilds Bend - Pool 5A
ALTERNATIVE 4


FROM: SEPT 1983 LAND USE ALLOCATION PLAN
732
PAP SLOUGH
ISLAND 63
SLOUGH
731
BETSY
ALTERNATIVE 5
(IOWA VANES)
730
CORPS LAND
FWS LAND
POLANDER
LAKE
729
McNALLY
LANDING
LOCK & DAM
5 A
0
1000
2000
3000
4000
5000 FEET
0
1 MILE
Wilds Bend - Pool 5A
ALTERNATIVE 5

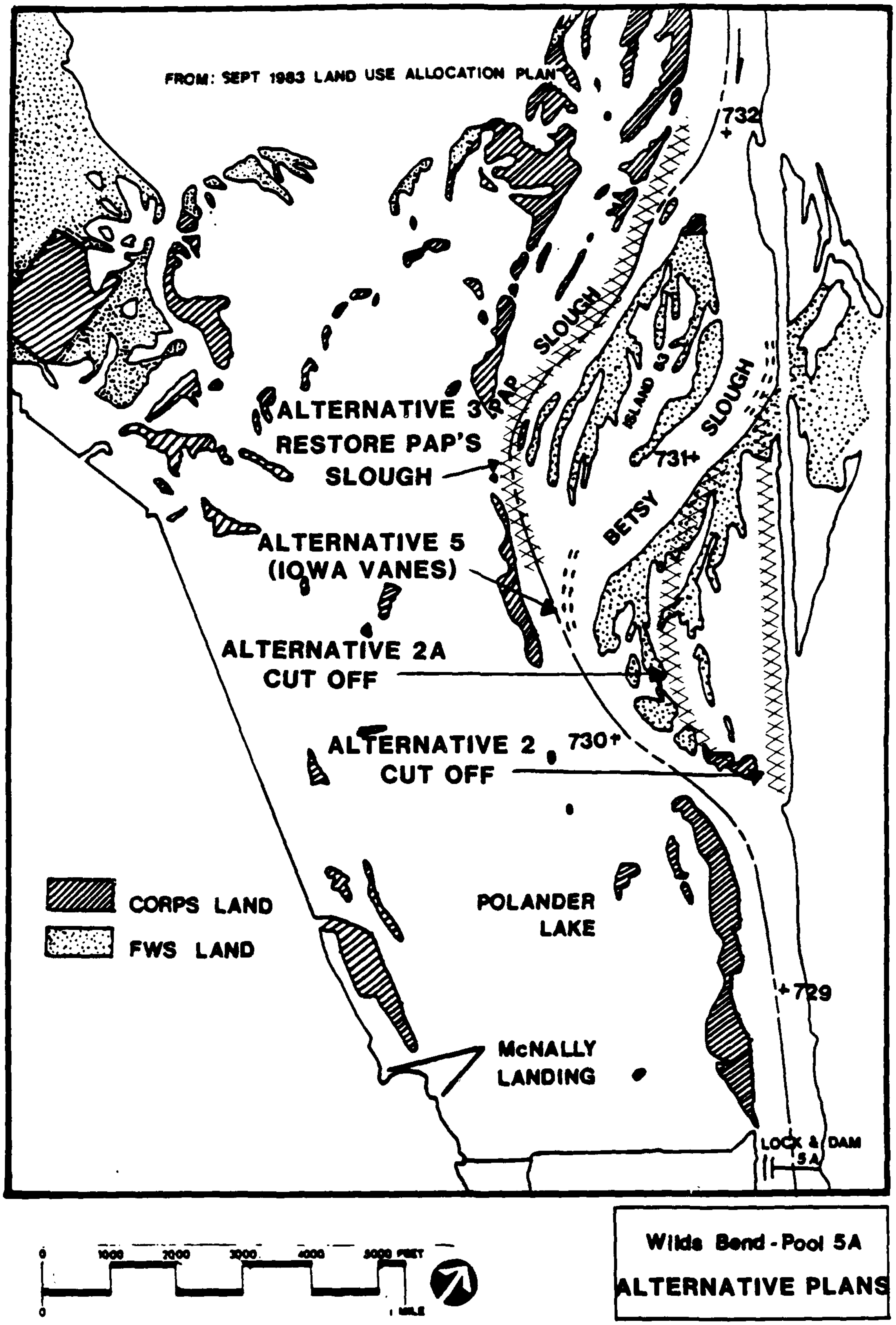
The reconnaissance report recommended that more detailed investigation be made of the navigation problem at Wilds Bend (mile 729 to 732), with particular regard to alternatives 2 and 2A (channel cutoffs), alternative 3 (restore Pap Slough), and alternative 5 (channel structures).

CURRENT INVESTIGATIONS

GENERAL

The current investigations are a continuation of the effort that was expended in the October 1985 reconnaissance study. Four of six construction alternatives identified in that study were evaluated in more detail, especially from the hydraulic, economic, and environmental feasibility standpoint. These alternatives are: (2) channel cutoff, (2A) bent channel cutoff, (3) restore Pap Slough, and (5) training structures in Betsy Slough.

The other two alternatives addressed in the reconnaissance report (alternatives (4) and (6)) were not reevaluated but simply restated for comparison purposes in this investigation. The locations of alternatives 2, 2A, 3, and 5 for this report are shown on the following figure.



Wilds Bend - Pool 5A
ALTERNATIVE PLANS

CONDITIONS IF NO ADDITIONAL FEDERAL ACTION IS TAKEN

Annual maintenance dredging would remain about the same or tend to increase, based on existing records (Appendix G), increase if no additional Federal action is taken. Safety conditions would remain less than desirable because tows would continue to have difficulty navigating the treacherous bends. The safety of the lock 5A structure and the tows would remain at risk.

Traffic delays would continue or increase, because river traffic tends to increase over time. As mentioned earlier, in the 1950's and 1960's tows were broken up above the Wilds Bend area and moved in two or more sections through the lock 5A structure. This procedure is not necessary now because of the advent of higher-powered (5,000-6,000 hp) towboats.

Upbound tows would continue to experience delays up to 1-1/2 hours while they wait for downbound tows to negotiate the Wilds Bend area.

Also, upbound tows, on the average, experience an additional 45 minutes loss in time traveling this reach of river because of the sinuosity of the channel.

PLANNING CONSTRAINTS

Any solution to the Wilds Bend problem must be technically and economically sound, socially and environmentally acceptable, and implementable.

Significant adverse effects on wild and scenic rivers, on historic sites, and on endangered species, migratory fish, wildlife, and other environmental resources must be assessed. Significant impacts should be eliminated if possible and mitigated when they cannot be eliminated.

PLANNING OBJECTIVES

Specific planning objectives are definite needs, opportunities, and problems that can be addressed to enhance national economic development or environmental quality. This study includes the following specific planning objectives:

1. Reduce dredging requirements in the Wilds Bend area.

2. Eliminate or reduce the safety hazard for tows that run aground while negotiating the treacherous river bends in the Wilds Bend area. Reducing this hazard would also reduce the chance of hazardous spills.

3. Improve the safety of the lock and dam 5A structure by improving the existing conditions involving crosscurrents and tows moving at angles to the lock upstream of the dam.

4. Reduce current navigation traffic delays and related costs.

5. Improve existing fish and wildlife habitat and/or recreational opportunities.

6. Minimize site-specific environmental effects of any plan proposal.

7. Minimize adverse effects on the historic and aesthetic environments.

PLAN FORMULATION

RATIONALE

The purpose of the formulation of preliminary plans is to identify and evaluate alternative measures for fulfilling the planning constraints and objectives. Plan formulation is iterative and designed to identify and evaluate all possible solutions so that the best and most feasible solution can be selected. The level of detail for this report is designed to identify the most feasible solution that can be evaluated further in a design memorandum and lead ultimately to plans and specifications for construction.

SCOPING

Alternatives were originally identified from previous correspondence and from discussions with the Construction-Operations and Engineering Divisions of the St. Paul District. These alternatives were evaluated in an October 1985 Reconnaissance Report.

Further information and input was obtained from the Channel Maintenance Forum at regular scheduled meetings.

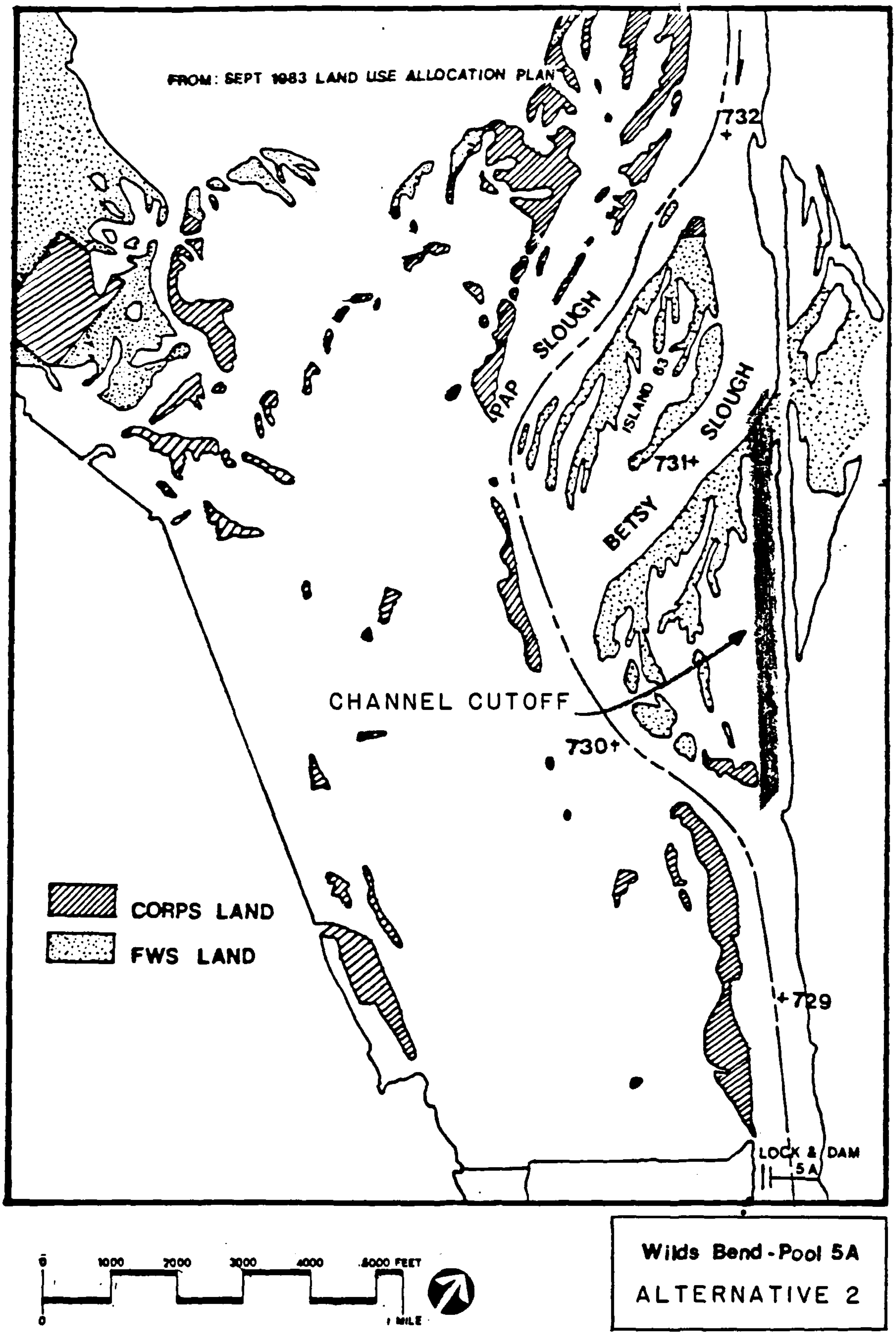
ALTERNATIVES

Alternative 1: Do Nothing

Under this alternative, the present frequency of dredging would stay constant or increase. Tows would continue to lose time because of the treacherous navigation aspects of the Wilds Bend (Betsy Slough) S-shaped channel. Dredging records from the past 29 years show an average annual dredge removal of 28,000 cubic yards (yd^3) from mile 730.2 to mile 732.0 at a cost of about $140,000.

Alternative 2: Channel Cutoff

At a minimum, this cutoff would involve excavating a 300-foot-wide bottom channel, 12 feet below low control pool (LCP), 6,200 feet long, with 3:1 side slopes. The excavation would remove about 597,000 yd^3. The channel would parallel the railroad tracks on the Wisconsin side. A low weir might eventually be needed at the head of Betsy Slough (present channel) but was not included in the present alternative. The channel would pass through U.S. Fish and Wildlife Service administered land and a small piece of Corps-owned land. (See the following figure (miles 729.5-732) and plate 1.)

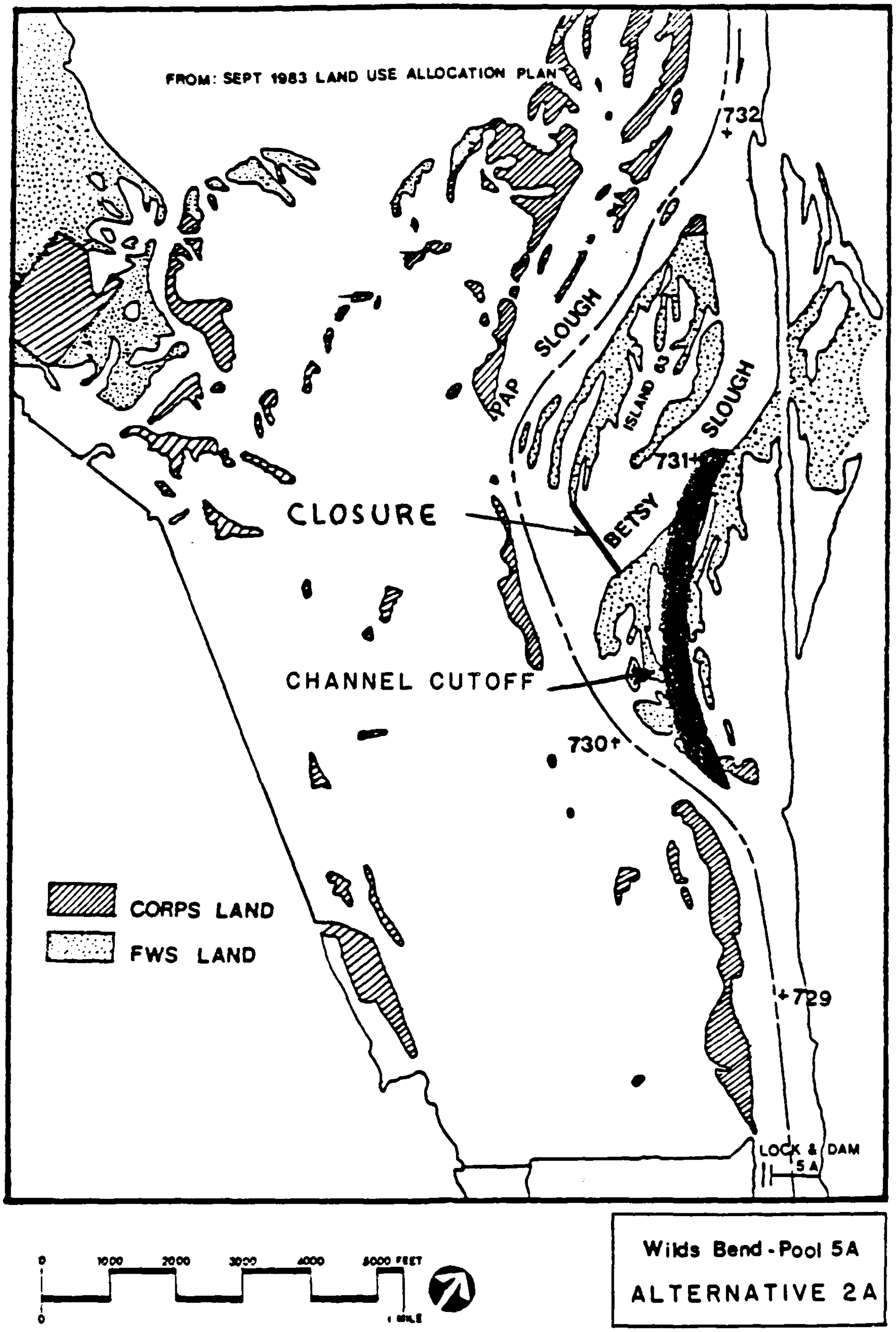

FROM: SEPT 1983 LAND USE ALLOCATION PLAN
732
PAP SLOUGH
ISLAND 63
BETSY SLOUGH
731
CHANNEL CUTOFF
730
729
LOCK & DAM 5A
CORPS LAND
FWS LAND
0
1000
2000
3000
4000
5000 FEET
0
1 MILE
Wilds Bend - Pool 5A
ALTERNATIVE 2

A decrease in dredging costs results with this alternative. Annual dredging is expected to be 18,200 yd^3 at a cost of $91,000, for the reach of channel from mile 729 to 732.0. The total cost of construction of the cutoff channel would be $4,052,665. Total annual cost of this alternative would be $446,400, with projected annual benefits of only $96,900. The benefit-cost ratio of this alternative is therefore 0.22. (See the preceding figure for alternative 2.)

Alternative 2A: Channel Cutoff

A variation of the cutoff alternative (alternative 2A) would involve 5,200 feet of dredged channel in the appropriate location as shown on the following figure. For this report, channel dimensions were assumed to be the same as for alternative 2. This variation would be more costly, would require a closure structure in Betsy Slough, but would be a more hydraulically stable channel than would the straight cutoff (alternative 2).

Annual dredging work amounting to 21,000 yd^3 and $105,000 would remain with this channel modification for the reach of channel mile 729.0 to 732.0. The total cost of construction of this cutoff variation would be $4,195,430. Total annual costs of this alternative would be $472,900, with annual benefits of only $82,900. The benefit-cost ratio of the alternative is 0.18. (See the following figure for alternative 2A, including a closure structure in Betsy Slough.)



Revised Sep 1987

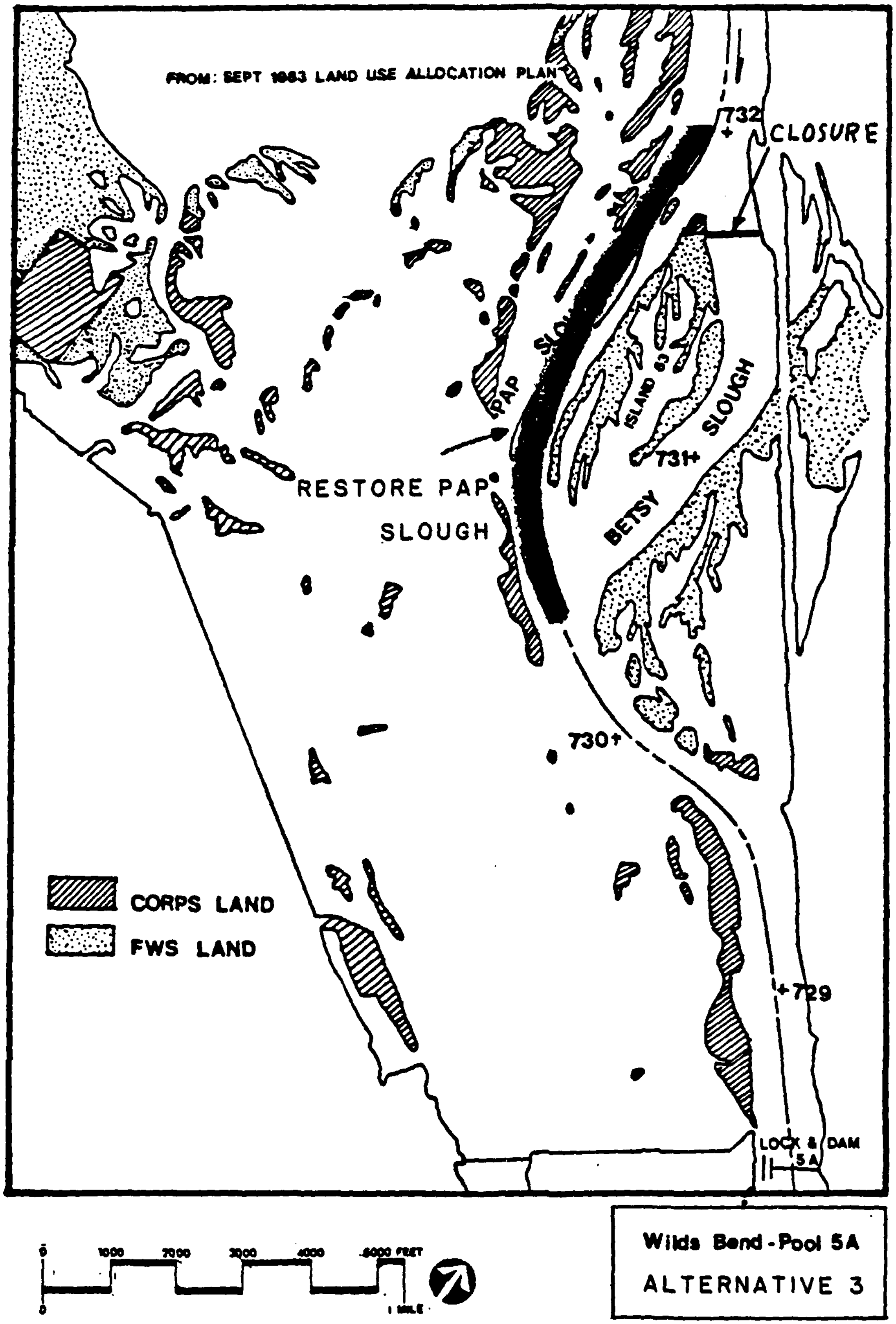
Alternative 3: Restore Pap Slough as Navigation Channel

The 8,500-foot-long section of Pap Slough channel appears to have been the main channel at the time of statehood. Restoring this channel as the main channel would maintain the sinuosity of the channel and would more likely be self-sustaining than would a straight cutoff channel. The restored channel would use the same channel cross section as alternative 2. A low weir at the head of Betsy Slough is required to make this alternative fully effective.

The first cost of construction, which would involve dredging out the old channel, would be $3,513,720. Annual dredging costs are estimated at $91,000, and total annual costs at $399,000. Annual benefits would be only $79,000, with a benefit-cost ratio of 0.20.

The amount of annual dredging that would remain with this alternative is estimated at 18,200 yd^3.

The following figure shows the location of alternative 3, including a closure structure on Betsy Slough.



Revised Sep 1987

Alternative 4: Overdredging Betsy Slough

This alternative would involve dredging the 8,000-foot-long Betsy Slough (present navigation channel) to some added dimension beyond what is presently involved in alternative 1 (do nothing). The proposed work might involve overdredging by 30 percent, in a 400- to 450-foot wide channel bottom with 3:1 side slopes, for example.

This alternative would eliminate neither the treacherous channel bends nor the traffic delays.

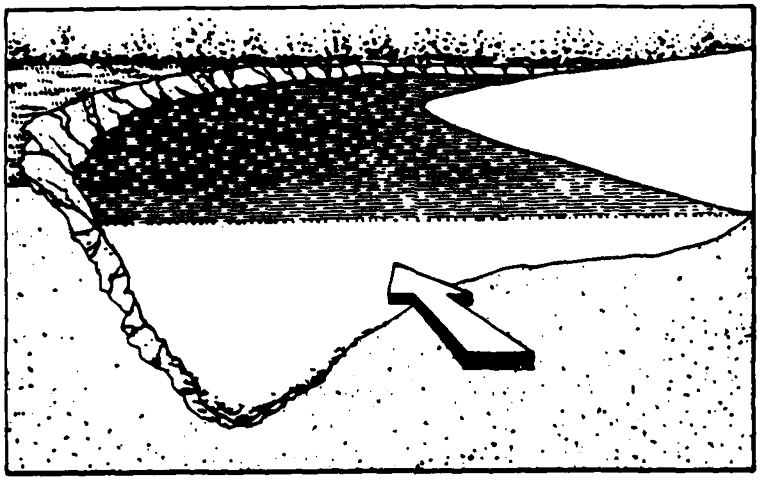
Future annual dredging costs might be increased only slightly, perhaps less than 10 percent. Estimated annual dredging would be 30,000 yd^3, at a cost of $150,000. First costs of this alternative would be $1,697,000, with total annual costs including dredging, of $299,000. There are negative annual net benefits with this alternative.

The location of alternative 4 is shown on the figure on page 14.

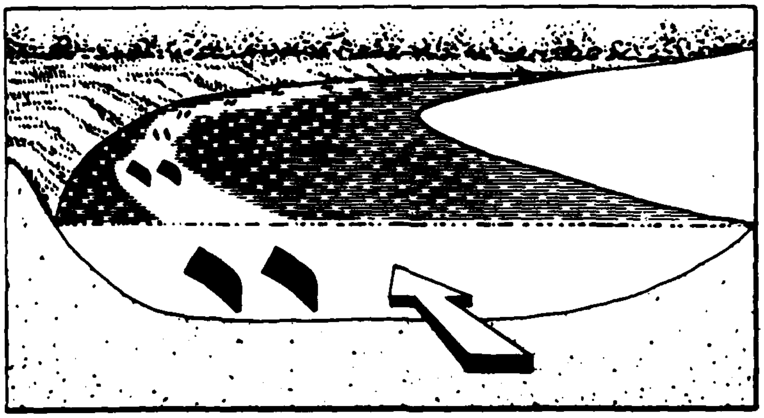
Alternative 5: Channel Structures

Channel structures (Iowa Vanes) strategically located in the 8,000-foot-long Betsy Slough (present channel) would be used to make the channel self-maintaining, to reduce dredging, and to make surface currents more suitable for towboat maneuvers through the bends. Iowa Vanes are shown on the following figure.

Iowa Vanes is a patent-pending concept developed by the Iowa Institute of Hydraulic Research (a division of the University of Iowa College of Engineering). A firm called Iowa Hydraulics Consultants, Inc., Iowa City, Iowa, has exclusive rights to proposals for design and installation of Iowa Vanes for erosion and sediment control. Any detailed work involving the Iowa Vane concept will require the involvement of the Iowa Hydraulics Consultants firm.



ERODING RIVER BEND



RIVER BEND STABILIZED WITH IOWA VANES

This alternative would provide desired benefits to navigation (eliminating delays caused by tows navigating the presently treacherous bends). Although the alternative would not provide a straight approach to the lock, it would affect surface currents in such a way as to make this reach of river more easily and safely navigable.

The October 1985 Reconnaissance Report analysis and preliminary estimate for this alternative assumed that 16 old wing dams (as shown on plates 2 and 3) were to be restored. Approximately 640 feet of wing dams were to be restored to an elevation 4 feet below flat pool (elevation 651.0) in the Betsy Slough channel from about mile 730.3 to mile 732.0. However, this concept was later determined to be as unreliable in the future as it has been in the past.

Consequently, although restoration of wing dams was used for the October 1985 Reconnaissance Report cost estimate of this alternative, this phase of study evaluation substituted the Iowa Vanes structural concept. Iowa Vanes are steep-sided structures placed on, and parallel to, the channel bottom. These structures are designed to counteract secondary currents present in bends and to prevent buildup of point bars. Iowa Vanes have been investigated only recently in model and prototype studies, but appear successful in stopping deposition and in redistributing current flow patterns in more desirable ways. The Iowa Vanes were first used on the East Nishnabotna River at Red Oak, Iowa.

The remaining dredging required in the Betsy Slough reach is estimated to be less (8,400 yd^3 and $42,000/year).

The first cost of construction for this alternative would be $223,200, with total annual costs including dredging, of $61,600. Annual benefits would be $128,000, with a benefit-cost ratio of 2.10 for this alternative.

The location of alternative 5, Iowa Vanes, is shown on the figure on page 17.

Alternative 6: Revised Operation Plan

This alternative would involve eliminating the present 1-foot pool drawdown from "flat-pool" (elevation 651.0) to secondary control (elevation 650.0) at approximately 24,000 cfs river flow.

The added 1-foot depth available is expected to aid navigation, decrease dredging requirements, and possibly reduce the effect of "outdraft" or pulling of tows toward the lock and dam 5A gated section during higher river flows. However, any benefits would be minimal and not measurable.

This alternative would eliminate neither the treacherous "S" bend nor the hazard of tows meeting on the bend. Hence, the traffic delays would still occur.

It is highly unlikely that a 1-foot raise in secondary pool level would provide a significant advantage to tows that approach lock and dam 5A. Actually, the secondary drawdown level at the lock was 2.5 feet below elevation 651.0 from 1936 to about 1959. An evaluation of hydraulic efficiencies in the pool at that time determined that the secondary level could be raised 1.5 feet without exceeding flowage easements originally obtained for controlled pool operation. Although the 1.5-foot raise has possibly helped the navigation situation since about 1959, by providing more depth above the lock during intermediate flows, a further raise of the secondary level by 1.0 foot could not be expected to materially aid navigation at lock and dam 5A. Also, this raise would probably require renegotiated flowage easements in most of the lower portion of pool 5A.

A 1.0-foot pool raise in flat pool elevation to 651.0 would have to be evaluated hydraulically and environmentally to see that existing flowage limits are respected and that environmental effects are accounted for.

No consideration was given to raising the flat pool level above elevation 651.0, the established normal level. This alternative was not seriously considered because of the added flowage easements required in the entire pool 5A. It is anticipated that the U.S. Fish and Wildlife Service and the Wisconsin and Minnesota Departments of Natural Resources would have strong objections to such a proposal. A flat pool raise proposal would be similar to suggesting a navigable depth greater than the present 9 feet. Also, a pool raise of this nature might only provide a temporary solution that would essentially be offset by sedimentation.

PLAN COMPARISON

HYDRAULICS

The previously identified alternatives were evaluated and compared with each other by means of a TABS-2 model. This computer model developed hydraulic profiles and velocity vector maps for alternatives 2, 2A, and 3. Alternative 5 was evaluated based on results of prior physical model studies completed by Iowa Institute of Hydraulic Research.

With and without project alternatives were developed for a flow range of 47,700 cfs to 86,000 cfs on hydraulic profiles. Velocity vector maps were developed for the 47,700 cfs flow. Observations were:

a. Water profiles:

Alternative 2:	Water surface lowered 0.1 to 0.2 foot.
Alternative 2A:	Water surface close to existing conditions.
Alternative 3:	Water surface close to existing condition and even higher level.

b. The elevation difference for alternatives 2 and 2A gets larger for higher flows, but for alternative 3, there is no difference from existing conditions for 73,000 to 86,000 cfs.

c. The 47,700 cfs figure starting point was the observed flow during field observations. The 86,000 cfs flow was a point where computed levels started to diverge from observed levels. The model could be modified to correct this inconsistency.

d. The velocity vectors do not change in Polander Lake with any of the alternatives.

e. A wing dam or closure dam was not used in Betsy Slough with alternatives 2 and 2A, although there is a provision to do so in the model.

From a strictly hydraulic viewpoint, the following alternatives are recommended in order of priority:

Alternative 5 - Betsy Slough structures - first choice
Alternative 3 - Pap Slough - second choice
Alternative 2A - Bent channel cutoff
Alternative 2 - Straight channel cutoff

ECONOMICS

Costs and benefits developed for each alternative are compared on the four tables that follow.

Cost Table
Wilds Bend Alternatives - Pool 5A

Item	Do nothing 1	Channel Cutoff 2	Channel Cutoff 2A	Restore Pap Slough 3	Overdredge Betsy Slough 4	Channel Structures 5	Revised Operating Plan 6
Contract Cost	0	$2,986,665	$3,091,430	$2,589,720	$1,250,000	$164,480	0
Contingencies (15% x contract cost)	0	448,000	464,000	388,000	188,000	24,700	0
Total Construction Cost	0	3,434,665	3,555,430	2,977,720	1,438,000	189,200	0
Engineering and Design (10% x total construction cost)	0	343,000	356,000	298,000	144,000	18,900	0
Supervision and Administration (8% x total construction cost)	0	275,000	284,000	238,000	115,000	15,100	0
Final Construction Cost	0	4,052,665	4,195,430	3,513,720	1,697,000	223,200	0
Annualized Construction Cost[1]	0	355,400	367,900	308,000	149,000	19,600	0
Annual Dredging Cost[2]	$140,000	91,000	105,000	91,000	150,000	42,000	$140,000
Total Annual Cost	140,000	446,400	472,900	399,000	299,000	61,600	140,000

[1]Figures are in October 1986 price levels, interest rates at 8 7/8-percent, and 100-year life (interest and amortization factor = 0.08877).

[2]Dredge disposal sites are available to handle the alternative excavations shown. Island construction in Polander Lake is another use for this material. (See section on Dredged Material Disposal.)

Benefits and Costs, Wilds Bend

Alternative	Costs				Annual Benefits			
	First Cost Construction	Annual Cost Construction	Dredging Costs (Annual Maintenance)	Total Annual Costs	Decrease in Dredging Costs	Transportation Savings	Safety Benefits	Railroad Benefits
1. Do Nothing	0	0	$140,000	$140,000	0	0	0	0
2. Channel Cutoff(1)	$4,052,665	$355,400	91,000	446,400	$49,000	$40,400	$7,500	0
2A. Channel Cutoff(1)	4,195,430	367,900	105,000	472,900	35,000	40,400	7,500	0
3. Restore Pap Slough	3,513,720	308,000	91,000	399,000	49,000	0	0	$30,000
4. Betsy Slough Overdredging	1,697,000	149,000	150,000	299,000	-10,000	0	0	0
5. Training Structures in Betsy Slough	223,200	19,600	42,000	61,600	98,000	0	0	30,000
6. Revised Operating Plan	0	0	140,000	140,000	0	0	0	0

(1) Assumes no riprap on new channel.

Figures are in October 1986 price levels, interest rate at 8 7/8-percent, and 100-year life (interest and amortization factor = 0.08877).

Plan Comparison

Alternative	Annual Benefits	Annual Costs	Benefit-Cost Ratio
1. Do Nothing	--	$140,000	--
2. Channel Cutoff	$96,900	446,400	0.22
2A. Channel Cutoff	82,900	472,900	0.18
3. Restore Pap Slough	79,000	399,000	0.20
4. Betsy Slough Overdredging	-10,000	299,000	--
5. Channel Structures in Betsy Slough (Iowa Vanes)	128,000	61,600	2.10
6. Revised Operating Plan	--	140,000	--

Figures are in October 1986 price levels, interest rates at 8 7/8-percent, and 100-year life (interest and amortization factor = 0.08877).

Benefit-Cost Table

Alternative Number	Railroad Benefits	Reduced Dredging Costs	Safety Benefits	Delays > 'Normal' Elapsed Times	Total Annual Benefits	Total Annual Costs	Benefit/ Cost/ Ratio
1	0	0	0	0	0	$140,000	-
2	0	$49,000	$7,500	$40,400	96,900	446,400	0.22
2 A	0	35,000	7,500	40,400	82,900	472,900	0.18
3	$30,000	49,000	0	0	79,000	399,000	0.2
4	0	0	0	0	0	299,000	-
5	30,000	98,000	0	0	$128,000	61,600	2.1
6	0	0	0	0	0	140,000	-

The benefit-cost table was developed considering four benefit categories: safety, transportation savings, savings to the railroad in annual maintenance, and decreased dredging costs.

After considerable analysis of data on lockages and boat traffic, it was determined there were some transportation and safety benefits with alternatives 2 and 2A. Savings from accident prevention were possible with 2 and 2A also. The two most serious incidents that occurred in the area involved jet fuel and oil spills. These spills were considered to be due more to pilot error than anything else, and they occurred with both boats upbound (one spill happened during a fog).

Benefits to the railroad grade by not having to place as much riprap were assigned to alternative 3 (Pap Slough) and alternative 5 (Iowa Vanes). The other alternatives were considered to continue having erosion damage to the railroad grade riprap much as it is at present.

Dredging cost savings was the fourth class of benefits. The estimates of dredging cost savings were based on engineering judgment. As indicated in the benefit-cost table, the structural alternative for Betsy Slough is the only cost effective alternative (benefit-cost ratio of 2.10). This alternative would also be justified using only dredging cost savings if that were necessary. Using only dredging cost savings gives a benefit-cost ratio of 1.59.

SAFETY AND TRANSPORTATION

Alternatives 2 and 2A would provide safety and transportation benefits. Alternative 3 might be somewhat safer but would not provide added transportation benefits. Therefore, no safety or transportation benefits were assigned to alternative 3.

RECOMMENDED PLAN

GENERAL

Selection of a recommended plan is influenced heavily by how much that alternative costs and whether it provides the maximum National Economic Development (NED) benefits.

The recommended plan is alternative 5 (channel structures). This plan has maximum NED benefits and minimal environmental effects. The plan goes a long way in reducing dredging costs but does not have as large an effect on safety or on transportation savings for navigation interests.

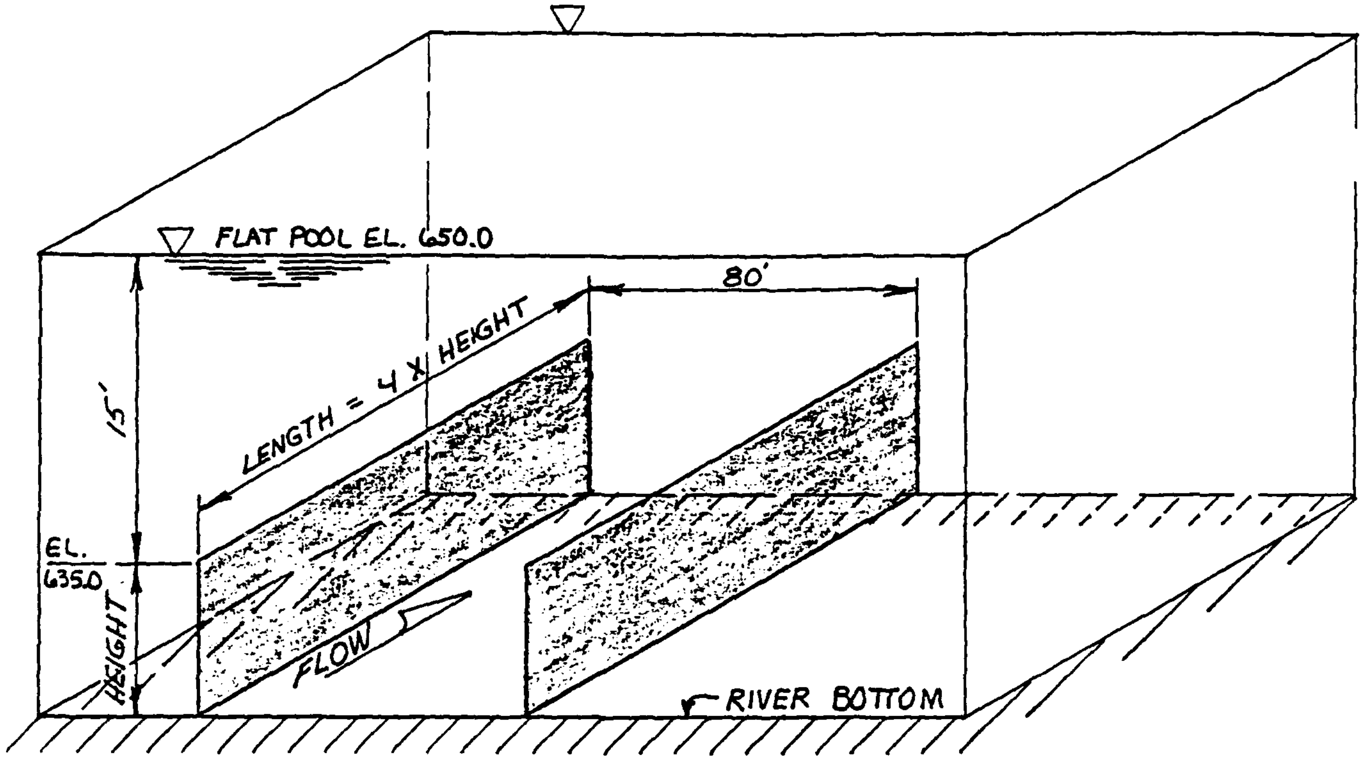
The recommended plan involves placing variable sized structures in two parallel lines along the riverbed of the main channel at two locations as shown on page 17. The structures will be like concrete highway barriers (Jersey barriers) or some type of piling. The vanes will be spaced 200 feet on centers, end to end, and the length of each vane will be four times the vertical exposure (see the following figure). The tops of the vanes will not exceed elevation 635.0, which is 15.0 feet below flat pool. Generally it is expected that the actual height of the vanes will vary from 4 feet to 17 feet.

COSTS

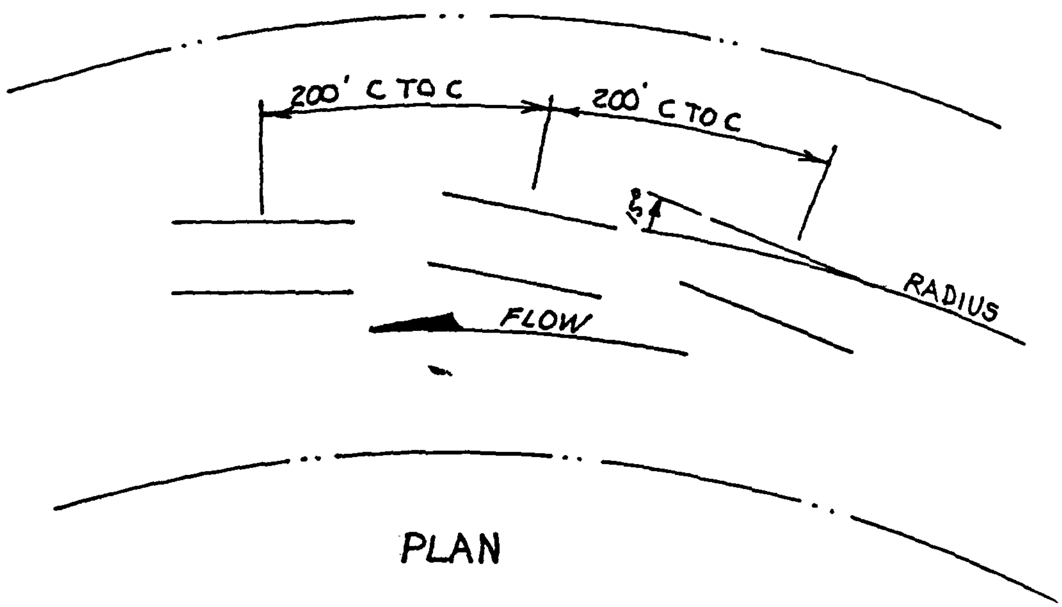
The total first cost of the recommended alternative is $223,200. The average annual cost is $61,600, including annual dredging costs which are $42,000.

BENEFITS

The total benefits for the recommended alternative are $128,000 annually with benefits attributable to decreased dredging costs and railroad benefits. Some minor safety benefits could occur with this alternative but none are shown.



DETAIL



PLAN

IOWA VANE INSTALLATION

(NOT TO SCALE)

BENEFIT-COST RATIO

The resulting benefit-cost ratio is 2.10.

MONITORING PROGRAM

Construction-Operations Division will establish a long-term monitoring program of the Iowa Vane installation to see how the project functions with regard to anticipated stream bed changes. The Environmental Resources Branch will coordinate in this monitoring effort and will evaluate biological and physical parameters for the project.

REAL ESTATE

The proposals for the Wilds Bend area, particularly the channel cutoff proposal, involve real estate owned by the U.S. Fish and Wildlife Service. A small piece of land owned by the Corps of Engineers also would be involved in the channel cutoff proposals.

The lands involved are shown on the lands and flowage rights drawing L/D 5A/9-1 (plate 1).

No real estate would be required by the recommended plan involving the Iowa Vanes.

DREDGED MATERIAL DISPOSAL

Three designated dredged material disposal areas are in the immediate vicinity of the Wilds Bend area. They are the Wilds Bend containment area (site 5A.08, mile 730.5), the Gotz site (site 5A.25, mile 732), and the Fountain City site (site 5A.32, mile 732). These sites are shown on figure 1 of Appendix G.

None of the dredged material disposal sites would be required with the recommended Iowa Vanes structural proposal.

GEOLOGY AND SOILS

In 1948, 12 borings averaging about 15 feet deep were taken along the alternative 2 channel cutoff alignment. Eleven of the borings were machine borings, and one was an auger boring.

No shear strength tests were made in 1948; however, mechanical analysis, natural moisture content, and a limited number of Atterberg limit and specific gravity tests were made.

The borings show clays and silts from the 1- to 5-foot depth and well-graded sands or poorly-graded river sands below that level. These borings were not plotted for the reconnaissance or alternatives study, but could be plotted with future work. Additional borings will be required for the Iowa Vanes structural proposal to guarantee stability of these structures.

CULTURAL RESOURCES

In accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, the National Register of Historic Places has been consulted. As of 23 July 1987, there are no sites listed on or eligible for inclusion on the National Register that would be affected by the proposed project. The selected alternative would not affect existing ground surfaces, so no cultural resource surveys would be necessary.

ENVIRONMENTAL CONCERNS

The placement of the Iowa Vanes represents the least environmentally damaging of the structural solutions proposed to solve the sedimentation problem in this reach of the river. The placement of Iowa Vanes would result in no negative impacts on the area's cultural, social, or recreational resources. The minimal construction activities associated with this alternative would result in relatively lower impacts on the biological resources as compared to the other proposed structural alternatives. In addition, this proposal would result in no changes to existing hydraulic conditions in Polander Lake. There is also the potential for positive secondary impacts. It is anticipated that the placement of these structures would reduce the frequency of future maintenance dredging. Such a reduction would result in less area being needed for dredged material disposal sites and therefore less chance to affect biological and cultural resources in these areas.

The proposed alternative has the potential for negative impacts on the aquatic resources of the area. A cycle of deposition and scour in the immediate vicinity of the structures has been noted in previous projects using these structures. It has been found that depressions located in the stream bed near these structures tend to fill in to a height no greater than the height of the vanes which are placed in the stream. This deposited material has tended to be scoured out during the next high flow period. There are a number of deep holes in the vicinity of the location of these proposed structures. These holes are known to provide important habitat for a number of fish species. The filling of the depressions, even on a temporary basis, would negatively affect the species using the holes.

LOCAL COOPERATION AND COST SHARING

There are no local cooperation and cost sharing requirements for this navigation rehabilitation project. Project costs will be borne by the Federal Government.

COORDINATION WITH THE PUBLIC

Public coordination was limited for this report. The purpose of this report was to reevaluate overall technical feasibility and to recommend a specific alternative for implementation in the Wilds Bend area. Individual towing company pilots and a former lock and dam 5A lockmaster were contacted by phone, meetings were held with Channel Maintenance Forum members and towing industry representatives, and their comments were used to develop potential project benefits and to incorporate alternatives. More information on the earlier interviews with the pilots and coordination is in Appendix A.

The Channel Maintenance Forum was kept advised of study progress throughout the reconnaissance and alternative report phases. The Channel Maintenance Forum will be furnished a copy of this report. The public has been advised of the project through the issuance of the public notice involved in the NEPA process.

MODIFICATION AUTHORITY DISCUSSION

The Corps of Engineers is responsible for maintaining the Mississippi River 9-foot navigation channel. Engineer Regulation (ER) 1165-2-119 provides guidance on the use of available authorities to make modifications to completed projects such as the 9-foot channel project:

> "8. <u>Modification Under Existing Authority, Multiple Purpose Projects</u>.
>
> a. Operations and maintenance authority. For projects operated and maintained by the Corps, the Corps responsibility for acceptable management of the project to serve the public interest confers a broad authority for making, as part of its operations and maintenance efforts, reasonable changes and additions to project facilities within the project boundaries as may be needed to properly operate the project or minimize maintenance. . . ."
>
> "9. <u>Modification under Existing Authority, Navigation Projects</u>.
>
> . . . Where not otherwise precluded by project authorization, the location of a completed channel may be altered during the course of the periodic maintenance program if the maintenance can thereby be more economically accomplished and related aids to navigation are readily adjustable to suit the restored channel dimensions at the shifted location."

The St. Paul District Office of Counsel has provided a July 10, 1985, legal opinion "that additional, specific authorization is not required to accomplish a channelization project at Wild's Bend, providing the (following) criteria are met."

". . . that modification be consistent. . . .with the existing authorization. . . . that corrective action is required to make the project function as initially intended by the designer in a safe, viable and reliable manner. . . . "

"Secondly, the proposed modification must not be required by changed conditions."

"Thirdly, the proposed corrective action should be limited to existing project features."

"The fourth requirement is that the proposed corrective work is economically justified, unless it is otherwise justified by safety reasons."

The Wilds Bend area has been a navigation problem area since the inception of the 9-foot channel project. Proposals to correct the problem date back to 1937, with several interim channelization efforts on record to obtain funds for such a project. Apparently the problem was not given sufficient emphasis in the past, however, and nothing was ever done. Navigation problems still exist.

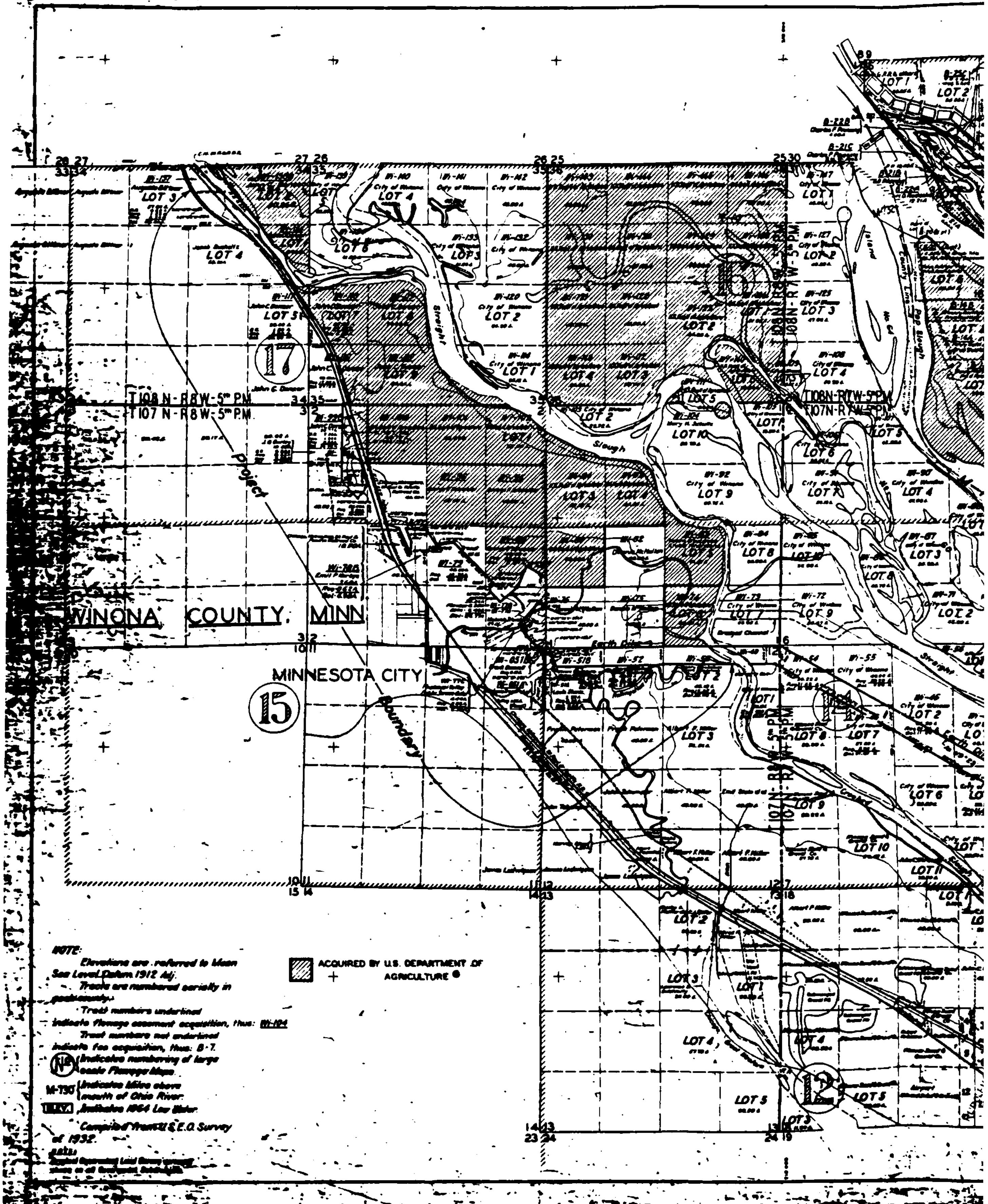
Navigation interests apparently experience some time delays (and additional expense), and the problem presents a safety hazard. However, after closer examination, no channel project was found to be cost effective. The current report has identified an alternative other than a channel project that still meets all the criteria set forth in the previously referenced July 10, 1985, legal opinion. Therefore, the recommended project can be constructed under either of the aforementioned authorities.

RESULTS OF THIS STUDY

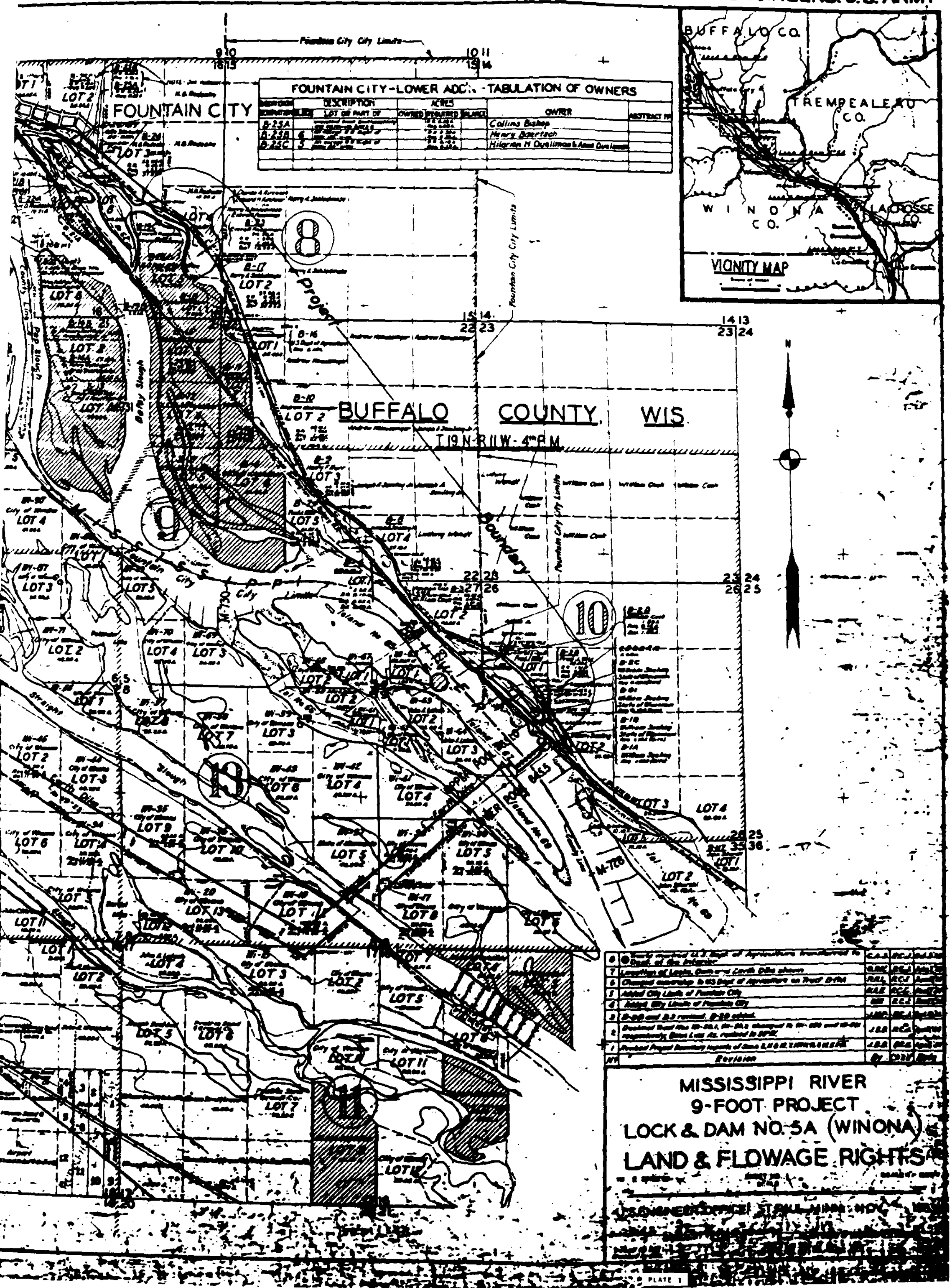
Alternative 5 (training structures in Betsy Slough) produces maximum net economic benefits and is the National Economic Development (NED) plan for more detailed design analysis.

As a result of the study, the following work will be performed: (1) hydraulic modeling of the Mississippi River between mile 729 and 732, with a movable bed model, and (2) detailed design analysis of the selected plan features in this reach of the river.

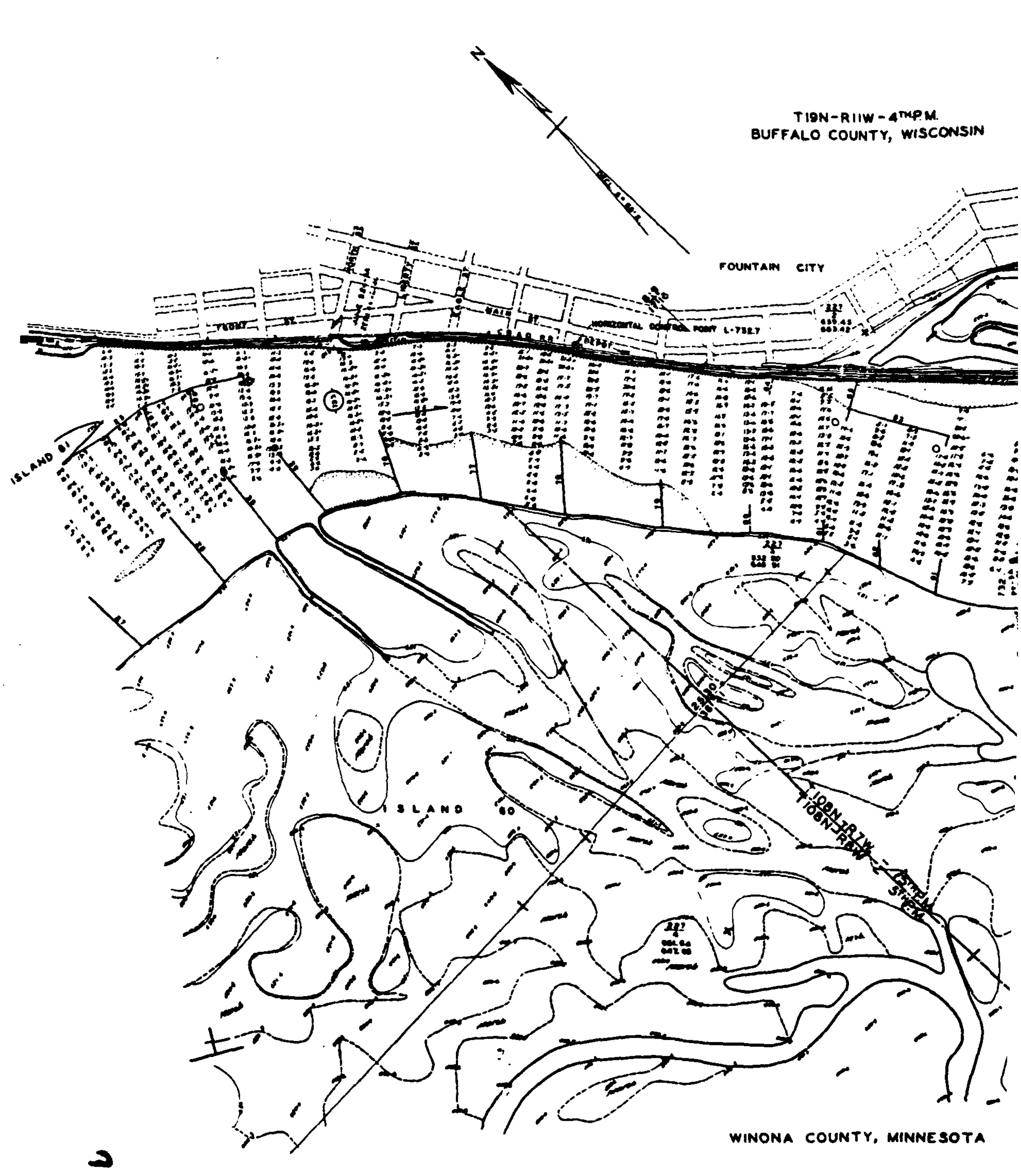
WAR DEPARTMENT



CORPS OF ENGINEERS. U.S. ARMY



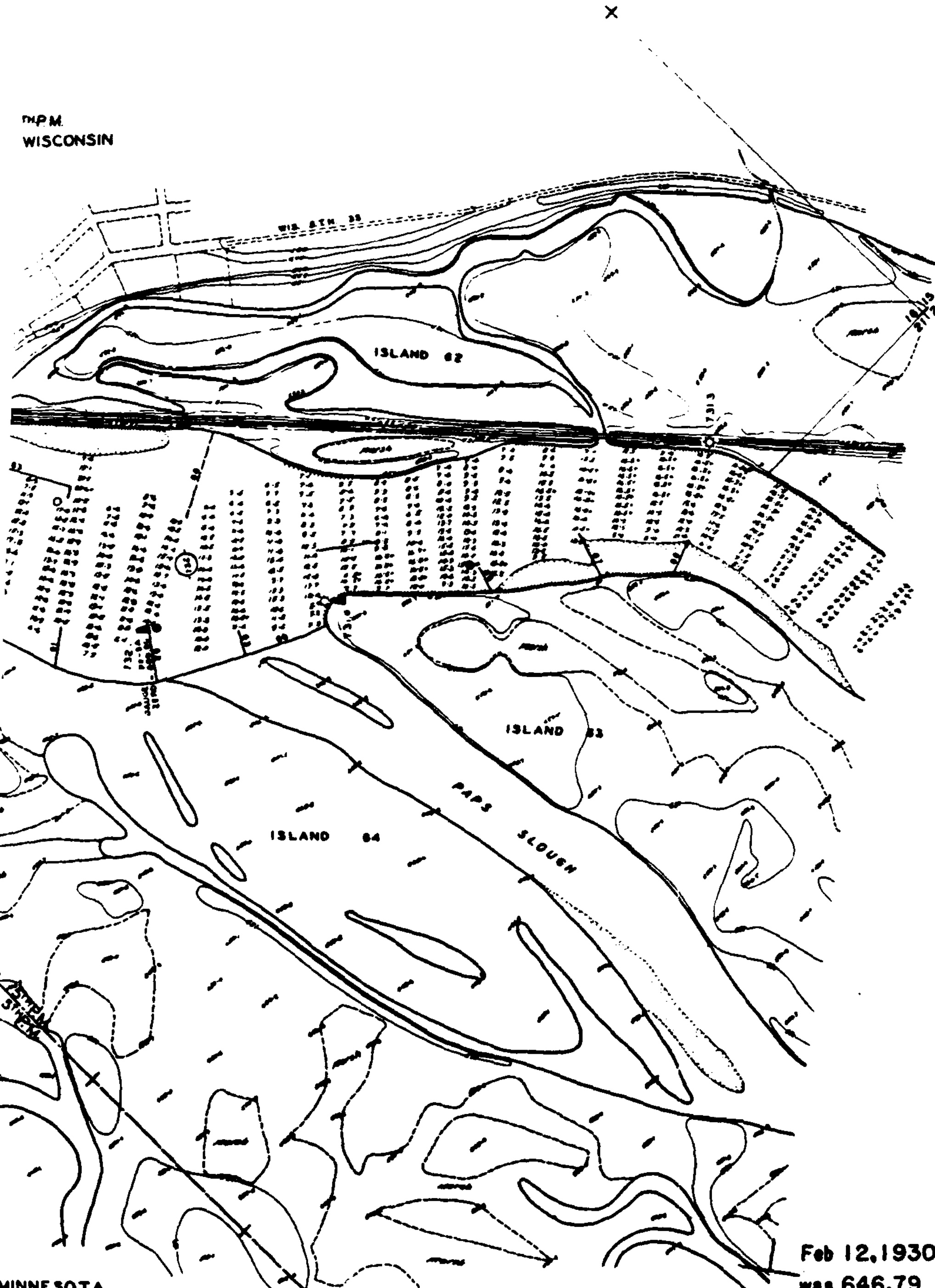
WAR DEPARTMENT



SYMBOLS

[illegible]	9-11-46	ADDED HORIZ. CONTROL POINT L-732.7
J.F.K.	9-24-44	CORRECTED POSITION OF LIGHT TO MILE 731.3
J.F.K.	9-24-44	CORRECTED POSITIONS OF CHANNEL MARKER PIERS
BY	DATE	REVISIONS

CORPS OF ENGINEERS U. S. ARMY.



Feb 12, 1930 W.S. elevation at Mile 731.8 was 646.79

SYMBOLS

NOTES

ELEVATIONS ARE BASED ON MEAN SEA LEVEL DATUM

SOUNDINGS ON THIS SHEET ARE PLOTTED AS DEPTHS BELOW FLAT POOL WHICH IS ELEVATION ... M.S.L.

THIS SHEET WAS TRACED FROM FLOWAGE SURVEY SHEETS

POOL NO. 5A CONTROL POINT AT MILE ...

MILE	L.C.P. ELEV.
[illegible]	[illegible]
[illegible]	[illegible]

POSITION OF CHANNEL MARKER PIERS CORRECTED USING COORDINATES COMPUTED BY SURVEY SECTION FROM FINAL SURVEY OF MARKER SITE LOCATIONS

UPPER MISSISSIPPI RIVER

CONTINUOUS SURVEY
POOL NO. 5A

CAIRO MILEAGE 731.1–733.4

SHEET NO. 3

GRAPHIC SCALE

U. S. ENGINEER OFFICE, ST. PAUL, MINN.

TRACED BY C. H. T.

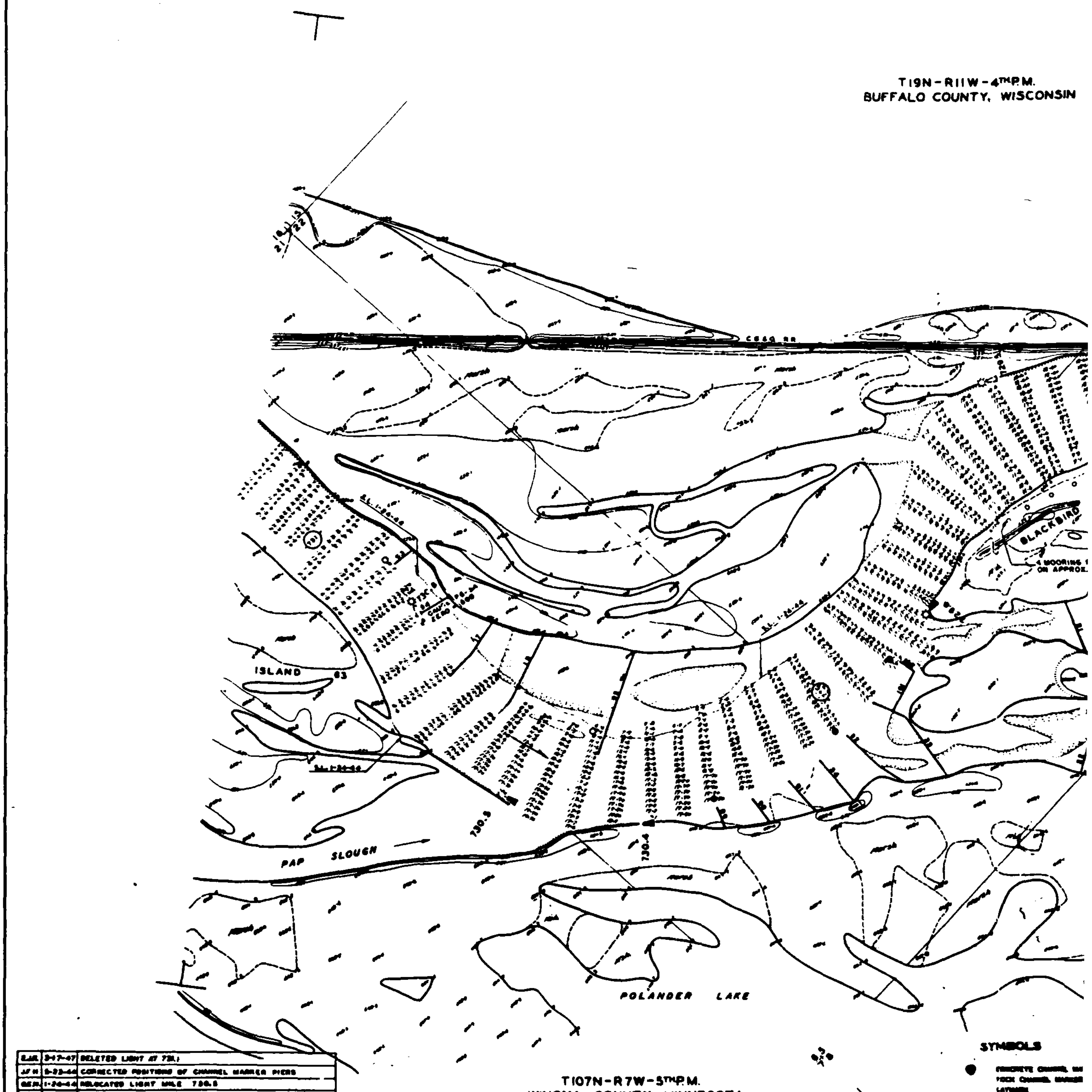
CHECKED BY C.H.T.

(40)

PLATE 2

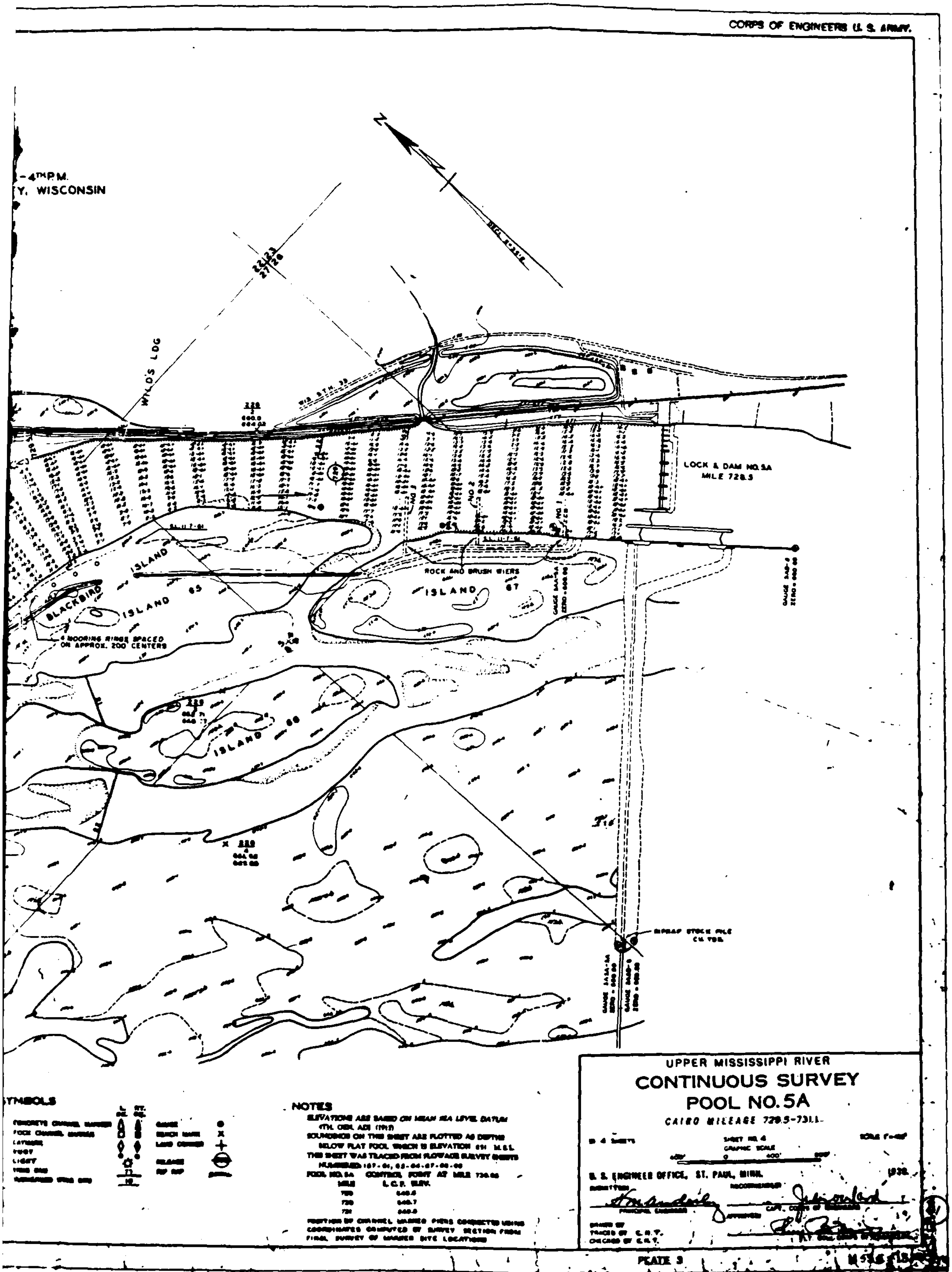
M-5A-13/3

WAR DEPARTMENT

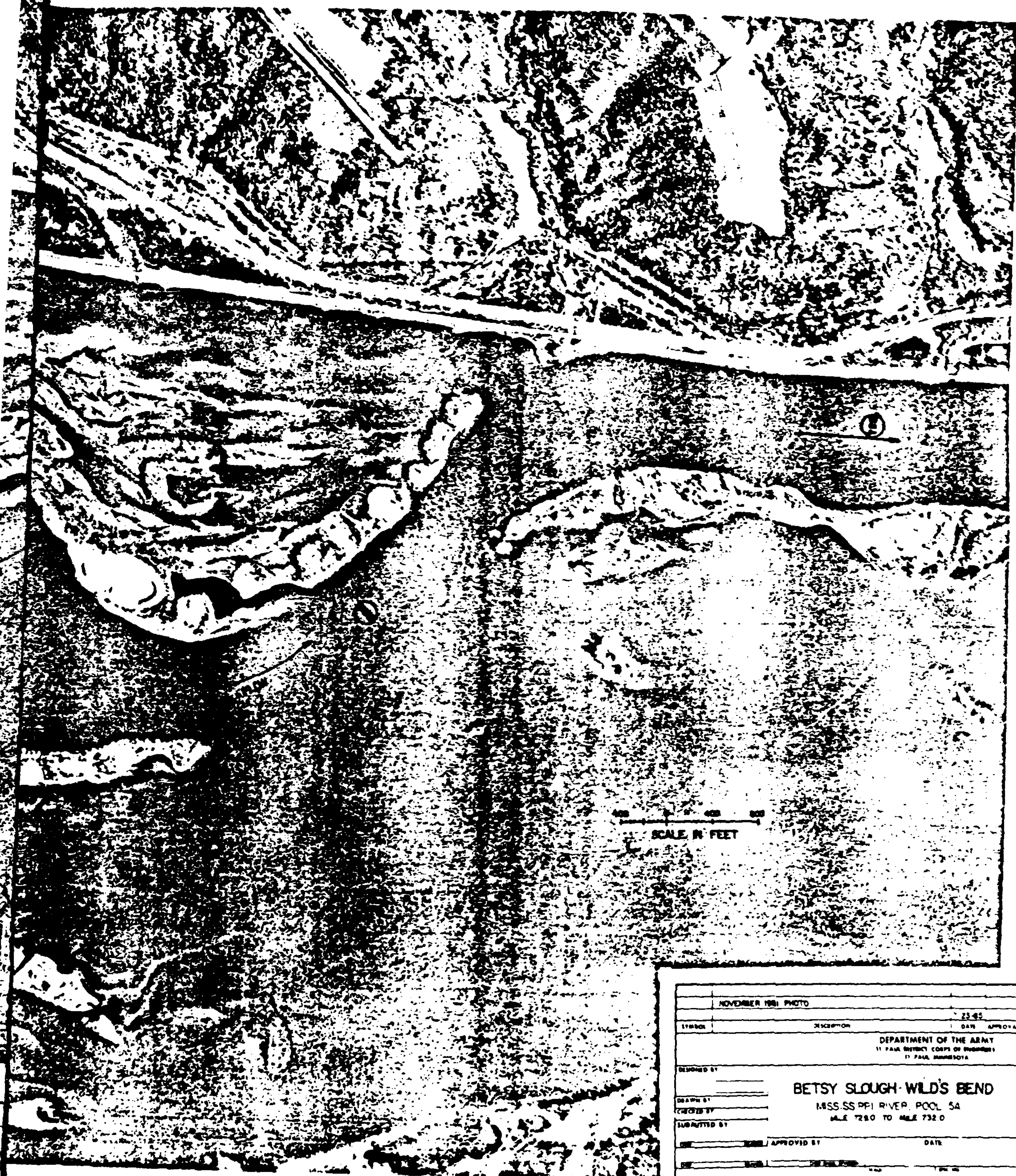


BY	DATE	REVISIONS
E.J.R.	3-17-47	DELETED LIGHT AT 731.1
J.F.H.	5-23-44	CORRECTED POSITIONS OF CHANNEL MARKER PIERS
G.E.H.	1-24-44	RELOCATED LIGHT MILE 730.5
G.E.H.	1-24-44	RELOCATED MARKER MILE 730.4
G.E.H.	1-24-44	EXTENDED LANDWARD END OF TRAILER DAM
G.E.H.	1-24-44	RELOCATED GAGE & MARKER MILE 729.9
G.E.H.	1-24-44	REVISED S.L. AS NOTED
G.E.H.	1-24-44	SHORTENED WING DAMS 34 [illegible]
G.E.H.	1-24-44	RELOCATED WING DAMS 17 10 & 94
G.E.H.	1-24-44	EXTENDED WING DAM 33

[illegible]	7-20-[illegible]	RELOCATED MOORING [illegible], ADDED [illegible] MILE 730.7, REVISED S.L.



CORPS OF ENGINEERS U. S. ARMY.
-4TH P.M.
Y, WISCONSIN
WILD'S LOG
LOCK & DAM NO. 5A
MILE 728.5
ROCK AND BRUSH WIERS
ISLAND
BLACKBIRD
ISLAND 65
ISLAND 67
ISLAND 66
4 MOORING RINGS SPACED ON APPROX. 200 CENTERS
RIPRAP STOCK PILE
SYMBOLS
NOTES
ELEVATIONS ARE BASED ON MEAN SEA LEVEL DATUM
SOUNDINGS ON THIS SHEET ARE PLOTTED AS DEPTHS
BELOW FLAT POOL WHICH IS ELEVATION 651 M.S.L.
THIS SHEET WAS TRACED FROM FLOWAGE SURVEY SHEETS
MILE
L.C.P. ELEV.
UPPER MISSISSIPPI RIVER
CONTINUOUS SURVEY
POOL NO. 5A
CAIRO MILEAGE 728.5-731.1
SHEET NO. 4
GRAPHIC SCALE
U. S. ENGINEER OFFICE, ST. PAUL, MINN.
1938
TRACED BY C. H. T.
CHECKED BY C. H. T.
PLATE 3



NOVEMBER 1981 PHOTO

DEPARTMENT OF THE ARMY

ST. PAUL DISTRICT, CORPS OF ENGINEERS

ST. PAUL, MINNESOTA

BETSY SLOUGH-WILD'S BEND

MISSISSIPPI RIVER, POOL 5A

MILE 728.0 TO MILE 732.0

DESIGNED BY

DRAWN BY

CHECKED BY

SUBMITTED BY

APPROVED BY

DATE

DRAWING NUMBER

SHEET OF

PLATE 4

ENVIRONMENTAL ASSESSMENT

Based on evaluations of the recommended plan, the St. Paul District's initial determination is that no significant impacts to the human environment would result from the project. The greatest potential for negative impacts would result from periodic partial filling of relatively deep holes in the river bottom near the location of the structures. A biological and physical monitoring program would be developed to determine what changes would occur in the areas in which the structures are located. The environmental assessment for this project is in preparation and should be sent out for public review within the next several months.

APPENDIX A

COORDINATION

APPENDIX A
COORDINATION

This appendix has three basic parts:

1. Coordination
2. Public Involvement
3. Correspondence

COORDINATION

Initial coordination in the reconnaissance study was limited to the Corps of Engineers and the Channel Maintenance Forum. The Channel Maintenance Forum consists of Federal and State representatives involved with the Mississippi River on a day-to-day basis, as well as representation from the commercial navigation interests. The Channel Maintenance Forum was kept apprised of the reconnaissance study progress and given copies of the October 1985 Reconnaissance Report and the draft September 1987 Alternatives Report. The Channel Maintenance Forum concurred in a decision to investigate the most likely alternative solutions which was accomplished in the current Alternatives Report. This forum also recommended at a 2 December 1987 meeting that a hydraulic model study be conducted on the Iowa Vanes proposal and the results be evaluated prior to detailed design analysis.

PUBLIC INVOLVEMENT

There was no involvement with the general public in this phase of the study. However, the Channel Maintenance Forum and Federal and State agencies were advised of the study findings. The public will be involved in the design phase of the study.

The general public has been advised of the project through issuance of the Public Notice in the NEPA process.

CORRESPONDENCE

TABLE OF CONTENTS

CORRESPONDENCE

Correspondence on file about hazardous conditions for tows in the Wilds Bend area of pool 5A is limited to 1968 and earlier. The material consists of a letter and several telegrams. The lack of correspondence after 1968 suggests that the towing interests have determined that previous Corps inactivity in the matter is unlikely to change and that they must "make do" with a bad situation. Construction-Operations Division advises that numerous letters of support would be forthcoming once the Corps notified the public of the possibility of a channel improvement project in the Wilds Bend area.

Telephone contacts were made with several Mississippi River commercial tow companies, their pilots, and with the former lock and dam 5A lockmaster for up-to-date views, in June 1985. These contacts confirm the above analysis. The contacts also indicate that some advantages have been realized in coping with the Wilds Bend situation over the past 25 years. These advantages stem from several factors:

1. Boats are higher-powered today, with 5,000-6,000 horsepower ratings. This enables the tow to "back out" of some situations where earlier they may have been swept into lock and dam 5A by the swift currents.

2. The decreased pool drawdown to secondary pool level since 1959 has been of some help. The 1-foot drawdown to elevation 650.0 provides more depth in the immediate vicinity above the dam than did the earlier 2.5 feet of drawdown to elevation 648.5.

This decreased drawdown also somewhat limits the prevailing water level differential between the west and east sides of lock and dam 5A during high-flow periods. At present, this differential can approach 1.75 feet between the water levels at the emergency spillway on the west and at the lock wall on the east.

UPPER MISSISSIPPI TOWING CORPORATION

7703 NORMANDALE ROAD
ROOM 110

MINNEAPOLIS, MINN. 55435

July 26, 1968

Colonel Richard Hesse
U. S. Corps of Engineers
1217 U. S. Post Office
St. Paul 1, Minnesota

SUBJECT: Wilds Bend Project

Gentlemen:

As we stated in our wire on 7/18/68, we believe it very important that the Corps of Engineers give high priority to improving navigation conditions above Lock #5A.

Under present conditions it is almost impossible for two tows to meet and pass each other between Titus Light, Mile 731.3, and Wilds Light, Mile 729.5, without running aground or involving a risk of collision.

Even when there were no other vessels in the area, towboats in our service have all experience difficulty manuvering around these extremely sharp bends. We have on past occasions, run aground on the bar points, missed the turns and hit the bank or knocked off a string of barges in our tow. In addition to the loss of barge rigging and the damage to our barges, there is, also, the danger of loose barge floating onto the Dam at Lock #5A.

The turn at Wilds Light, Mile 729.5, is so sharp that it puts a tow on the opposite side of the River from the approach to Lock #5A, Mile 728.5, with only a mile to cross the River and line up with the Lock. If another boat is northbound out of the Lock and a southbound boat is manuvering this turn, it would be almost impossible to avoid a collision that would scatter barges onto the Dam at Lock #5A.

We will be very happy to hear that the Corps of Engineers has been able to give this project high priority in the future work schedule.

Yours very truly,

UPPER MISSISSIPPI TOWING CORPORATION

GH Chapman

Vice President

GHChapman/mm

WATER TRANSPORTATION OF BULK COMMODITIES IN BARGELOAD LOTS THROUGHOUT THE ENTIRE INLAND WATERWAYS

Class of Service

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1217P CDT JUL 18 68 MA101

DED151 DE ATA048 PDF ALTON ILL 18 1205P CDT

COL HESSE DISTRICT ENGINEER

US CORP OF ENGINEERS

ST PAUL MINN

DUE TO SHORT NOTICE GIVEN THE NAVIGATION INTEREST IN REGARD TO CLOSING THE BUDGET FRIDAY JULY 19TH WE URGE YOU TO INCLUDE SUFFICIENT MONIES IN THE BUDGET TO RECHANNEL WILDS BEND. A SUPPORTING DOCUMENT INCLUDING DELAYS ETC. TO OUR VESSELS WILL FOLLOW

18 JUL 68 AM

K W SCOGGINS PRESIDENT MIDWEST TOWING CO INC

19TH

(1211).

U S [illegible] DISTRICT
ST. PAUL, MINN

SF1201(R2-65)

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1015A CDT JUL 19 68 MB064 DEC061

DE ATA041 PD ALTON ILL 19 1000A CDT

COL HESSE, DISTRICT ENGINEER
US CORP OF ENGINEERS
ST PAUL MINN

DUE TO SHORT NOTICE GIVEN THE NAVIGATION INTEREST IN REGARD TO CLOSING THE BUDGET FRIDAY JULY 19TH WE URGE YOU TO INCLUDE SUFFICIENT MONIES IN THE BUDGET TO RECHANNEL WILDS BEND. A SUPPORTING DOCUMENT INCLUDING DELAYS ETC. TO OUR VESSELS WILL FOLLOW

19 JUL '68 AM

PAUL STRIEGEL PRESIDENT BIG T TOWING CO

19TH
(1008).

U. S. ARMY ENGINEER DISTRICT
ST. PAUL, MINN.

SF1201(R2-65)

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19 JUL 68 PM

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1234P CDT JUL 19 68 MB105

SA069 S LLL98 PDB 5 EXTRA FAX ST LOUIS MO 19 1215P CDT

DISTRICT ENGINEER, U S ARMY ENGINEER DISTRICT ST PAUL CORPS OF ENGINEERS

U.S. ARMY ENGINEER DISTRICT
ST. PAUL, MINN.

1217 US POST OFFICE & CUSTOM HOUSE ST PAUL MINN

RESPECTFULLY REQUEST THAT YOUR BUDGET FOR 1970 INCLUDE FUNDS TO IMPROVE NAVIGATION CONDITIONS IN VICINITY OF LOCK 5A AND WILDS BEND, UPPER MISSISSIPPI RIVER. OUR TOWS ENCOUNTERING NUMEROUS DELAYS, GROUNDINGS AND EXPENSE IN OPERATING THROUGH THIS REACH OF RIVER. CHANNEL SHOULD BE RE-ALIGNED, THROUGHOUT THIS REACH OF RIVER MORE DETAILS WILL BE GIVEN IN LETTER TO FOLLOW

D L BEAVER MARINE SUPERINTENDENT THE VALLEY LINE ST LOUIS MO

(1226).

...

SF1201(R2-65)

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408P CDT JUL 19 68 MB180

DEB276 DE JVA024WR RX PD JEFFERSONVILLE IND 19 450P EST

DISTRICT ENGINEER ST PAUL DIST

CORP OF ENGINEER CUSTOM HOUSE ST PAUL MINN

U. S. ARMY ENGINEER DISTRICT
ST. PAUL, MINN.

WITH REFERENCE TO AREA OF WILDS BEND U.M.R. WE ESTIMATE THAT THE HAZARDS CREATED BY AND WITHIN THIS AREA WHICH ALSO CONTRIBUTE TO HAZARDS AT LOCK 5A CAUSE OUR VESSELS TO LOOSE IN EXCESS OF 19,500 ANNUALLY CORRECTION OF THE HAZARDOUS ASPECT OF THE RIVER AT THIS POINT COULD BE READILY ACCOMPLISHED

CARL A SHELTON MARINE SUPT AMER COML BARGE LINE JEFFERSONVILLE INDIANA

(455).

SF1201(R2-65)

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1220P CDT JUL 19 68 MA113

SA065 S LLU75 PDB 8 EXTRA FAX ST LOUIS MO 19 1211P CDT

ST PAUL DISTRICT CORPS OF ENGINEERS

1217 U S POST OFFICE & CUSTOM HOUSE ST PAUL MINN

U.S. ARMY ENGINEER DISTRICT ST. PAUL MINN

URGENTLY REQUEST THAT FUNDS BE MADE FOR THE WILD'S BEND PROJECT. NOT ONLY WILL IT MAKE A MUCH BETTER RIVER TO NAVIGATE (SAVING ONE HOUR PER TOW), BUT WILL ALSO ASSIST THE CORRECTION OF THE HAZARDOUS OPERATION AT 5Q. DURING PERIODS OF HIGH WATER, TOWS ARE REQUIRED TO TRIPLE TRIP THIS REACH OF THE RIVER. TRIPLE TRIPPING REQUIRES THE MOORING OF BARGES TEMPORARILY TO THE BANK, WHICH MAKES THEM VULNERABLE TO BREAKAWAYS, THEREBY ENDANGERING GOVERNMENT PROPERTY (SAVINGS-THREE HOURS PER TOW).

W B FOUTS PRESIDENT MID-AMERICA TRANSPORTATION COMPANY 301 NORTH MEMORIAL DRIVE ST LOUIS MISSOURI 63102

(1215).

SF1201(R2-65)

19 JUL '68 PM

U.S. ARMY ENGINEER DISTRICT
ST. PAUL, MINN.

~~1. DEN~~
~~2. ED-P~~
3. AS-MF
2a CO

C OF ENG ST P

THIS IS UMTC - MPLS 7/19/68 1155 AM CDT

COLONEL HESSE

1217 U S POST OFFICE

ST PAUL MINN

WE RECOMMEND TO CORPS OF ENGINEERS THAT WILDS BEND PROJECT BE GIVEN PRIORITY FOR REMEDIAL ACTION TO REDUCE HAZARDS IN NAVIGATING UPPER APPROACH TO LOCK 5A.

OUR BOATS EXPERIENCE DELAYS FROM 2 HOURS TO 6 HOURS BECAUSE OF FLANKING BENDS AND AT TIMES HOLDING UP ABOVE WILDS BEND WAITING FOR PASSAGE OF NORTHBOUND BOATS. EXTREME HAZARDS IN NAVIGATING THIS STRETCH OF RIVER ESPECIALLY DURING HIGH WATER NECESSITATES REDUCTION OF SIZE OF TOWS FOR PURPOSE OF SAFETY AND AVOIDING ACCIDENTS

LETTER MORE FULLY EXPRESSING OUR INTEREST IN EARLY ACTION AND REASONS FOR SAME TO FOLLOW NEXT WEEK

GALE H CHAPMAN

UPPER MISSISSIPPI TOWING CORPORATION

END OR GA

MR. SILVERMAN

For action by__________

CF 111 IL PDF 10 EXTRA
JUL 18 347PCDT

Messages

12

THE ST PAUL DISTRICT CORPS OF ENGINEERS CAN INCLUDE IN ITS 1970 BUDGET A REQUEST FOR FUNDS TO CORRECT HAZARDS AT WILDS BEND IF THE DISTRICT ENGINEER RECEIVES ~~XXXX~~ CARRIER SUPPORT DURING FRIDAY JULY 19, 1968. PLEASE IMMEDIATELY WIRE THE DISTRICT ENGINEER ST PAUL DISTRICT CORPS ~~CORPS~~ OF ENGINEERS DISCRIBING GENERALLY HAZARDS ENCOUNTERED, THE NATURE OF DELAYS AND THE ~~XXXX~~ ESTIMATED COSTS OF ~~XXXX~~ DELAYS BEING EXPERIENCED BY YOUR TOWS AT ~~XX~~ WILDS BEND. FOLLOW WIRE WITH LETTER ~~XX~~ CITING SPECIFIC INSTANCES OF DELAY AND COST OF DELAY AND INCIDENTS OF HAZARDS AND ANY OTHER INFORMATION YOU FEEL MIGHT BE PERSUASIVE. WIRE NOW MAIL LETTER NEXT WEEK.

DEAN K JOHNSON
EXECUTIVE SECRETARY
UPPER MISSISSIPPI WATERWAY ASSOC
715 FIRST NAT'L BANK BLDG
MINNEAPOLIS

CONFIRMATION COPY

PDF 333-4361
SAME

CFN FURNISHED

STEVE TELL UPPER MISSISSIPPI TOWING CORP 7705 ~~XXXXXXXXXX~~
NORMANDALE RD MPLS

PAUL STRIGEL PHONE 465-5308 ALTON ILL

MR CREELMAN NATIONAL MARINE SERVICE PHONE 968-2700 STL

BAXTER SOUTHERN SOUTHERN TOWING CO CARUTHERSVILLE MO

NICK COIL PRESIDENT UNIVERSAL MARINE NRLNS

MR CATLENER FEDERAL BARGE LINES 611 EAST MARCEAU ST STL

ROBERT HUFFMANN HUFFMANN TOWING CO STL

J CLARKE BERRY ~~ZX~~ CAMARO BARGE LINE 226 CARONDELET ST NRLNS

L J SULLIVAN MISSISSIPPI VALLEY BARGE LINE 411 NORTH 7 ST STL

~~CATP~~ CAPTAIN WILLARD B FOUTS PRESIDENT MID AMERICA TRANSPORTATION CO 301 NORTH MEMORIAL DR STL

JACK WOFFORD AMERICAN COMMERCIAL BARGE LINES 1030 EAST MARKET
JEFFERSONVILLE IND

LAMETTI AND SONS 2560 CLEVELAND AVE NORTH STPAUL MINN

NODLAND ASSOCIATES BOX 612 ALEXANDRIA MINN

PETER LAMETTI 615 DRAKE STPAUL MINN

ORFEI
~~XXXXX~~ AND SONS 1156 HOMER ST STPAUL MINN

INTERPACE 1527 UNIVERSITY AVE STPAUL MINN

ERWIN MONTGOMERY 2150 WEST COUNTY ROAD D STPAUL MINN

MCDONALD ASSOCIATES 211 NORTH E PASCAL STPAUL MINN

THE STATE HISTORICAL SOCIETY OF WISCONSIN

H. Nicholas Muller III, Director

816 State Street
Madison, Wisconsin 53706
608 262-3266

HISTORIC PRESERVATION DIVISION

August 4, 1987

Mr. Charles E. Workman, Chief
Environmental Resources Branch Plan. Div.
St. Paul District,Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101-1479

SHSW: #87-1265
RE: Place Iowa Vanes In Betsy Slough

Dear Mr. Workman:

We have reviewed the above referenced project as required for compliance with Section 106 of the National Historic Preservation Act and the "Procedures for the Protection of Historic and Cultural Properties" (36 CFR 800).

There are no properties listed in the National Register of Historic Places located within the area of the proposed undertaking. Furthermore, we are not aware of any properties that may be eligible for the National Register in this area. No further actions are necessary for compliance with Section 106 and 36 CFR 800 provided that there are no revisions to current project plans.

If you have any questions on this matter, please contact me at (608) 262-2732.

Sincerely,

Richard W. Dexter

Richard W. Dexter
Chief, Compliance and Archeology
Section

RWD:lkr

0581a

1665a

Department of the Army
St. Paul District, Corps of Engineers
1135 USPO & Custom House
St. Paul, MN 55101-1479

September 29, 1987

Environmental Resources
Planning Division

Mr. Robert Welford
St. Paul Field Office
U.S. Fish and Wildlife Service
Suite 50
Park Square Court
400 Sibley Street
St. Paul, Minnesota 55101

Dear Mr. Welford:

In accordance with the Endangered Species Act, we wish to obtain your comments on the potential impacts of the proposed channel maintenance activities at Wilds Bend (River Mile 730.5) on the Upper Mississippi River upon Federally designated threatened and endangered species.

The proposed plan involves placing variable sized structures in roughly two parallel lines along the riverbed of the main channel at the locations shown on the attached figure. The intent of these structures is to reduce the amount of dredging currently needed to maintain the navigation channel at this point on the river. These types of structures have been tried on smaller rivers in Iowa and found to reduce the amount of sedimentation. The shape and composition of the precast structures to be used in this action have not been determined, but the height of the structures would be no more than one-third the height of the water column at the point where they are placed and the top of the structures would be at least 15 feet below the normal pool elevation. The construction technique would depend on the design of structures used. These techniques could range from merely lowering the structures to the bottom of the channel to driving in support pilings. With any of these construction methods, the disruption to the environment would be no greater than what would occur with the dredging activities. The proposed action would eliminate the need for dredging, and it would be a one time activity as opposed to repeated dredging actions.

We have conducted a biological assessment of the proposed activities to determine their potential effects upon the following species: Higgins' eye pearly mussel (Lampsilis higginsi), peregrine falcon (Falco peregrinus), and bald eagle (Haliaeetus leucocephalus). There are no known concentrations of the mussel in this reach of Pool 5A. The falcons, which had been extirpated from the river valley, have been reintroduced, but none are known to frequent the proposed project area. Eagles are fairly common in the project area, especially during the spring and fall migratory season. The proposed actions should cause no increase in the disturbance to the eagles' general activities. During the past year, an eagles' nest was established in Polander Lake, a backwater area downstream from the project site. The pair using the nest were unsuccessful in producing young and it is uncertain whether the nest will be used in the future. If the nest is used again, the proposed construction would be scheduled to minimize any disturbance to the nesting activities.

Based upon these determinations and findings, we conclude that the proposed action would have no significant impacts on threatened and endangered species. We would appreciate your comments on this conclusion.

Sincerely,

Enclosure

Charles E. Workman
Chief, Environmental Resources Branch
Planning Division

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ST. PAUL FIELD OFFICE, (ES)
50 Park Square Court
400 Sibley Street
St. Paul, Minnesota 55101

IN REPLY REFER TO:
SPFO

October 14, 1987

Mr. Charles E. Workman
Chief, Environmental Resources Branch
Planning Division
U.S. Army Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101-1479

Dear Mr. Workman:

This is in response to your September 29, 1987 letter concerning potential impacts on federally endangered or threatened species from the proposed channel maintenance activities at Wilds Bend in Pool 5A of the Upper Mississippi River.

Based on information contained in your above referenced letter and the nature of the Wilds Bend Project and the habitat requirements of the federally threatened bald eagle (Haliaeetus leucocephalus), endangered peregrine falcon (Falco peregrinus), and endangered Higgins' eye pearly mussel (Lampsilis higginsi), we support your contention that the project will not affect federally endangered or threatened species. This precludes the need for further action on this proposal as required under Section 7 of the Endangered Species Act of 1973, as amended. Should the Wilds Bend project be modified or new information indicates listed species may be affected, consultation with this office should be reinitiated.

These comments have been prepared under the authority of and in accordance with provisions of the Endangered Species Act of 1973, as amended.

Sincerely,

James L. Smith

James L. Smith
Assistant Field Supervisor

APPENDIX B

ECONOMIC ANALYSIS

TABLE OF CONTENTS

Tables

APPENDIX B
ECONOMIC ANALYSIS

BACKGROUND

The Upper Mississippi River system is an integral part of a broad regional, national, and international transportation network. As such, it has played and will continue to play a key role in the economic growth and development of the Upper Midwest and numerous river communities.

As an important corridor of transportation, the Upper Mississippi River system has, since 1824, been subject to navigational alterations. In the 1930's, Congress authorized 9-foot navigation channel projects for the Mississippi River. The 9-foot channel was achieved by the construction of locks and dams, wing dikes, and other structures; and it is supplemented by dredging. Construction of the locks and dams was essentially completed by 1940, with a few exceptions. Lock and dam 5A was completed and placed in operation in 1936. The series of locks and dams on the Upper Mississippi River from Upper St. Anthony Falls in Minneapolis, Minnesota, to St. Louis, Missouri, provides a navigable "stairway of water."

The Upper Mississippi River system transports large quantities of agricultural products, coal, petroleum, chemicals, and other commodities. These commodities represent the inputs and outputs of the large, agriculturally-oriented base of the surrounding region. The benefits of the inland river system, disbursed locally, regionally, and nationally, have been well documented in previous studies. Accordingly, the following analysis concentrates only on the benefits of improved navigation safety at Wilds Bend and the approach to lock and dam 5A.

The Wilds Bend Reach (1) lies between Fountain City, Wisconsin, and lock and dam 5A of the Mississippi River 9-foot navigation channel project. The Mississippi River makes three bends before straightening out a mile upstream of the lock and dam. The river channel bends are difficult to navigate and require almost annual maintenance dredging. The present channel bend at river mile 729.5 puts a downbound tow on the opposite side of the river from the approach to lock and dam 5A, at mile 728.5 (2). At that point, tows have only 1 mile to cross the river and line up with the lock. If an upbound tow coming out of the lock were to encounter a downbound tow in this reach, they would have a high probability of collision. A collision would likely scuttle barges onto lock and dam 5A. Therefore, downbound tows will tie off along the east bank to let upbound tows pass. The three bends are especially difficult to navigate at high water conditions. The Wilds Bend Reach is bordered on the east side by a railroad embankment and on the west side by Paps Slough and the Upper Mississippi Fish and Wildlife Refuge.

---

(1) Wilds Bend Reach as referred to in this report extends from river mile 729.0 to 732.0 above the mouth of the Ohio River, at Cairo, Illinois.

(2) Upper Mississippi River miles are measured above the mouth of the Ohio River, at Cairo, Illinois.

The primary purpose of the lock is to provide navigation through the dam, into or out of pool 5A. In 1986, 10.4 million tons of various commodities (2.9 million tons upbound and 7.5 million tons downbound) passed through lock 5A. This movement of commodities required the use of 1,221 commercial tows. Commodity flows through lock 5A for the 5-year period 1982-1986 are outlined in table 1.

Table 1 - Commodity flow data (1982-1986), lock and dam 5A*

Commodity	1982	1983	1984	1985	1986	TOTALS	5 Yr Average
Chemicals	941.0	1095.0	1450.0	1461.0	1466.0	6413.0	1282.6
Coal	1643.0	1518.0	1081.0	1163.0	1155.0	6560.0	1312.0
Farm Prod.	8534.0	12081.0	10304.0	7221.0	5864.0	44004.0	8800.8
Petroleum	1140.0	1009.0	1082.0	1125.0	951.0	5307.0	1061.4
Other**	594.0	926.0	960.0	982.0	1054.0	4516.0	903.2
TOTAL	12852.0	16629.0	14877.0	11952.0	10490.0	66800.0	13360.0

* In thousands of tons.
** This category includes metallic ores, metal products, waste and scrap materials, non-metallic minerals (except fuels), stone, clay, glass, concrete, and miscellaneous products.

Detailed monthly directional breakdowns of commodity movements for 1985 and 1986 are in tables 2 and 3. Table 4 documents the number of commercial tows that passed through lock 5A by month for 1985 and 1986. As a comparison, light boat and noncommercial lockages totaled 3,263 representing 4,484 craft in 1986. All statistics are from the Corps of Engineers Performance Monitoring System (PMS).

Table 2 - Upbound commodity flow data by month (1985-1986), lock and dam 5A*

	Chemicals			Coal			Farm Products			Petroleum			Other**			TOTAL	
Month	1985	1986	Avg.	1985	1986	Avg.	1985	1986	Avg.	1985	1986	Avg.	1985	1986	Avg.	1985	1986
March	64	110	87	1	0	1	0	0	0	0	0	0	23	8	16	88	118
April	155	287	221	63	36	50	0	0	0	7	4	6	57	67	62	282	394
May	146	178	162	69	127	98	1	0	1	36	9	23	109	67	88	361	381
June	87	162	125	80	87	84	0	1	1	21	0	11	112	119	116	300	369
July	108	82	95	78	94	86	0	0	0	32	13	23	122	114	118	340	303
August	84	160	122	111	80	96	0	0	0	41	41	41	91	125	108	327	406
September	119	85	102	101	72	87	0	0	0	22	64	43	122	157	140	364	378
October	183	51	117	92	41	67	0	8	4	16	7	12	149	159	154	440	266
November	157	119	138	32	35	34	22	3	13	23	21	22	111	134	123	345	312
December	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1,103	1,234	1,169	627	572	600	23	12	18	198	159	179	896	950	923	2,847	2,927

* In thousands of tons.

** This category includes metallic ores, metal products, waste and scrap materials, non-metallic minerals (except fuels), stone, clay, glass, concrete, and miscellaneous products.

Table 3 - Downbound commodity flow data by month (1985-1986), lock and dam 5A*

	Chemicals			Coal			Farm Products			Petroleum			Other**			TOTAL	
Month	1985	1986	Avg.	1985	1986	Avg.	1985	1986	Avg.	1985	1986	Avg.	1985	1986	Avg.	1985	1986
March	0	0	0	28	0	14	217	77	147	7	0	4	1	0	1	253	77
April	68	32	50	49	13	31	913	482	698	150	62	106	11	3	7	1,191	592
May	44	39	42	72	69	71	901	690	796	128	73	101	7	11	9	1,152	882
June	17	11	14	90	80	85	843	806	825	94	104	99	9	6	8	1,053	1,007
July	25	0	13	92	88	90	1,023	872	948	100	179	140	10	21	16	1,250	1,160
August	66	64	65	66	95	81	886	1,056	971	114	127	121	9	14	12	1,141	1,356
September	88	54	71	95	112	104	740	635	688	115	104	110	4	8	6	1,042	913
October	39	29	34	43	108	76	585	482	534	122	80	101	18	9	14	807	708
November	11	3	7	1	18	10	1,016	752	884	97	63	80	16	32	24	1,141	868
December	0	0	0	0	0	0	74	0	37	0	0	0	1	0	1	75	0
TOTAL	358	232	295	536	583	560	7,198	5,852	6,525	927	792	860	86	104	95	9,105	7,563

* In thousands of tons.

** This category includes metallic ores, metal products, waste and scrap materials, non-metallic minerals (except fuels), stone, clay, glass, concrete, and miscellaneous products.

Table 4 - Commercial tow lockage data by month (1985-1986), L&D 5A

	Upbound Tows			Downbound Tows			TOTAL TOWS *		
Month	1985	1986	Avg.	1985	1986	Avg.	1985	1986	Avg.
March	35	16	26	20	9	15	55	25	40
April	88	60	74	84	54	69	172	114	143
May	91	78	85	97	80	89	188	158	173
June	79	71	75	77	77	77	156	148	152
July	87	86	87	89	86	88	176	172	174
August	82	106	94	80	95	88	162	201	182
September	72	74	73	75	77	76	147	151	149
October	74	62	68	67	65	66	141	127	134
November	59	55	57	79	69	74	138	124	131
December	0	1	1	9	0	5	9	1	5
TOTAL	667	609	638	677	612	645	1,344	1,221	1,283

* Excludes all lightboats.

HISTORY OF THE PROBLEM

This reach has long been a problem for navigation interests and for the Corps of Engineers, which must dredge the bends almost annually to maintain the 9-foot channel. The excessive maneuvering needed to navigate the channel in this reach also causes significant erosion of the adjacent railroad embankment. Requests that the Corps investigate these problems date back to 1937.

In the 1950's and 1960's, as tows became larger, the bigger tows had to be broken up into several sections, causing river traffic delays. The advent of higher-powered boats and more frequent maintenance dredging seem to have eliminated the need to break up tows. However, considerable delays are still a daily occurrence in the Wilds Bend Reach. Upbound tows often wait up to 1-1/2 hours at mile 729 to allow downbound tows to safely navigate the Wilds Bend Reach. Individual delays vary from 45 minutes to 1 hour and 45 minutes. Sometimes two upbound tows tie off and wait for downbound tows in this area at the same time.

The Wilds Bend Reach is one of the worst areas within the St. Paul District in terms of accidents and spills. Two major barge spills occurred in this reach, both in May 1978; one involved 120,000 gallons of jet fuel and the other involved 1,000 gallons of crude oil. The potential for environmental impacts is quite significant. From Betsy Slough, the main commercial navigation route, flow is oriented into the Polander Lake area, a very productive wildlife area.

CURRENT ACCIDENT REPORTS

The record of reported towboat groundings in the District office files is not complete; it is most comprehensive for the last 6 years (1981-1986). Examination of these records shows one to eight reported groundings in any particular year in the Wilds Bend Reach. Time delays varied from 15 minutes to 15 hours for these reported groundings. An analysis of the PMS data for 1984 and 1985, the only years for which detailed data is available, indicates that groundings do not delay tows meeting or following the grounded tow. However, discussions with construction-operations personnel familiar with the Wilds Bend Reach indicate that some of the longer travel times are the result of unreported groundings. They believe pilots are reluctant to report groundings and many groundings go unreported. All reported groundings from 1981 through 1986 and all recorded information about the groundings are presented in table 5. Prior to 1981, records were insufficient for analysis.

Half of the groundings occurred during June and July, and only one of the vessels had more than one accident, although this does not mean that the same river pilot did not ground more often than that. The tow horsepower ranged from 3,800 to 6,140, with most of the tows in the middle of that range. According to the information available, the groundings occurred entirely on the west side of the channel, but neither the upbound nor downbound direction appears to have more problems. All the groundings are reported to have happened from river mile 730.0 to 732.0, with the majority of the groundings occurring between river mile 731.0 and 732.0. One to 16 barges were the load at any given time but the larger loads between 11 and 15 barges had the most problems. With all the barges, no spills were

Table 5 - Groundings at Wilds Bend, UMR

Year	Month	Date	Name of Vessel	Vessel ID Number	Horse Power	Direction	Side of Channel	River Mile	Time Grounded	Time Released	Delay Time Hours	Delay Time Minutes	Number of Barges Loaded	Number of Barges Empty	Number of Barges Total	Elapsed Time Hours	Maximum Draft of Barges	Circumstances (Remarks)
1986	August	5	Cecil I. McMillan	630998	6140	Down	NA	731.00	0800	NA	1	20	12	0	12	4.25	NA	Black buoy missing
1986	October	21	Altonian	635415	6000	Up	NA	731.00	NA	NA	NA	NA	6	0	6	2.60	NA	NA
1985	November	1	Ecb Labdon	617935	4500	Up	NA	731.00	1305	NA	0	25	9	7	16	2.95	9.3'	NA
1986	November	3	Hawkeye	273767	4200	Down	NA	729.00	NA	NA	4	NA	9	0	9	1.45	NA	NA
1985	November	11	Badger	287337	3800	Down	NA	731.00	0001	NA	NA	30	3	1	4	1.12	NA	NA
1985	May	29	Force Chicago	533682	4200	Down	Right	731.30	0915	NA	2+	0	1	0	1	5.93	9'	May have channel closed
1985	June	10	Mary H. Morrison	602461	3800	Down	Right	731.30	0645	NA	2	45	15	0	15	4.27	9'	NA
1995	June	15	Leonard L. 82	551548	1400	Down	NA	731.00	NA	NA	NA	NA	3	0	3	11.09		
1985	October	27	Mercury	664965	5100	Up	NN	731.30	0730	NA	NA	NA	12	4	16	2.13	NA	Captain called, He said he did not actually get aground, but bumped bottom about 30 to 40 feet off the black buoys. Pool reading at the time was 649.86 A launch 16 was dispatched to site 10-29-85
1985	October	13	Lucy Logan	563966	5850	Up	Center	731 to 730	1400	NA	NA	NA	1	14	15	2.50	NA	Pilot said he dredged all the way through Betsy Slough area running 80' of red's with empties on starboard side. Moved buoys on 11-15 with Hauser
1984	June	10	Evey T	558474	4300	Down	NA	731.50	1000	NA	8	25	15	0	15	11.15	9'	8' of water 70' off black
1984	June	12	Fredrick Wells	602459	3800	Down	NA	731.00	1415	NA	14	45	12	0	12	14.07	9'	NA
1984	July	19	John Paul Eckstein	602136	5600	Up	NA	730.00	0745	NA	0	15	4	7	11	1.95	9'	Pilot was moving very slow, easy to release
1984	July	28	Jennifer Ann	272877	1350	Up	NA	731.20	1140	NA	2	0	6	9	15	3.92	9'	NA
1984	July	31	ContiMan	628776	4200	Down	NA	730.50	1000	NA	7	0	14	0	14	9.26	9'	NA
1984	August	4	Mercury	664965	5100	Down	NA	730.90	NA	NA	NA	NA	NA	NA	1	4.96	NA	NA
1984	November	21	White Knight	271429	3200	Down	NA	731.00	NA	NA	NA	NA	NA	NA	1	6.08	NA	NA
1984	November	26	Ted Marler	283017	330	Up	NA	732.00	1155	NA	0	22	5	0	5	NA	8.3'	40' from black
1983	March	20	Geo. Lambert	NA	NA	NA	Right	731.00	NA	NA	NA	NA	NA	NA	12	NA	9'	NA
1983	May	27	Thomas Martin	515428	3800	NA	Right	731.00	NA	NA	NA	NA	NA	NA	15	NA	9.6'	NA
1982	June	10	NA	NA	NA	NA	Right	730.90	NA	NA	NA	NA	NA	NA	NA	NA	NA	Black buoy missing
1982	June	10	Bluegrass	563779	5600	NA	Right	731.00	NA	NA	NA	NA	NA	NA	1	NA	NA	Black buoy missing
1981	June	24	NA	NA	NA	NA	Right	731.40	NA	NA	NA	NA	NA	NA	NA	NA	NA	2 Black buoys missing

Sources:

Coast Guard and

Disposition forms, NCSCO-PO

NA - Not Available

Note: No cargo spills were reported during this time frame.

recorded for the period of 1981 to 1986. Of the 23 groundings, the most common cause (8 groundings) was the location of black navigation buoys or the absence of the buoys entirely. Another reason cited for groundings was that the channel was not the minimum 9-foot channel.

ANALYSIS OF DELAYS

Regression analysis was done on the 1986 PMS data to determine a variable to explain the elapsed time (1) and quantify delays. Excluded from the complete PMS data are all the helper boats, lightboats, and the vessels that were not recorded to have locked through both lock and dam 5 and 5A. A total of 23 vessels or 1.9% of the complete PMS data are excluded because the elapsed time cannot be calculated due to a missing arrival or departure time at lock and dam 5 or lock and dam 5A (2). The selected data was then broken into three groups for analysis. The first group included all the selected 1986 PMS data, the second group excluded traffic which exceeded 6 hours of elapsed time, and the third group excluded traffic which exceeded one standard deviation from the mean of elapsed time. There were 23 different runs performed to include all the possible combinations utilizing elapsed time as the dependent variable in all cases. The independent variables were total barges or full barges, horsepower, discharge, and if it was night or day. The greater the R-squared, the more of a relationship the independent value(s) have on the elapsed time, 0.50 or greater is normally considered strong. The goal was to find a factor(s) that would accurately explain the elapsed time. This would then be used in the further analysis of the alternatives.

In the event of upbound traffic (table 6), the highest R-squared is 0.192659. This occurred when the dependent variable was elapsed time and the independent variables were total barges, discharge, horsepower, and night or day. This is not a strong R-squared and therefore indicates that none of the tested independent variables combinations can be used as a strong predictor. Similar results developed from the downbound traffic (table 7). The R-squared in this case, however, is 0.211551, which is considerably higher but still insignificant. In the downbound case, the independent variables indicate that full barges had more impact than total barges.

The regression analysis performed indicates that none of the independent variables considered can predict delays in the Wilds Bend Reach.

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(1) Selected data assumes that there was one tow with one or more barges per lockage; any other vessels that locked through are assumed to be lightboats which consisted of zero barges. This assumption was made because the number of double lockages is too few to affect the ending results of this study.

(2) Elapsed time is the time it takes to travel from lock and dam 5A to lock and dam 5 or vice versa.

Table 6 - WILDS BEND regression analysis results *

UPBOUND TRAFFIC ANALYZING ALL DATA FROM PMS DATA IN 1986

Dependent Variable	Independent Variables X1	X2	X3	X4	R-Squared R2
Time	Total Barges	---	---	---	0.005316
Time	Full Barges	---	---	---	0.008092
Time	Horsepower	---	---	---	0.005044
Time	Discharge	---	---	---	0.011615
Time	Night/Day	---	---	---	0.007210
Time	Total Barges	Discharge	---	---	0.010264
Time	Total Barges	Horsepower	---	---	0.029268
Time	Total Barges	Night/Day	---	---	0.012102
Time	Total Barges	Discharge	Horsepower	---	0.032682
Time	Total Barges	Horsepower	Night/Day	---	0.035067
Time	Total Barges	Night/Day	Discharge	---	0.016600
Time	Total Barges	Discharge	Horsepower	Night/Day	0.038160
Time	Full Barges	Discharge	---	---	0.014175
Time	Full Barges	Horsepower	---	---	0.028428
Time	Full Barges	Night/Day	---	---	0.014565
Time	Full Barges	Discharge	Horsepower	---	0.033552
Time	Full Barges	Horsepower	Night/Day	---	0.034049
Time	Full Barges	Night/Day	Discharge	---	0.020110
Time	Full Barges	Discharge	Horsepower	Night/Day	0.038730
Time	Horsepower	Night/Day	---	---	0.018447
Time	Night/Day	Discharge	---	---	0.011784
Time	Discharge	Horsepower	---	---	0.015713
Time	Night/Day	Discharge	Horsepower	---	0.022144

* UPBOUND TRAFFIC EXCLUDING DATA THAT EXCEEDED 6 HOURS OF ELAPSED TRAVEL TIME FROM PMS DATA IN 1986

Dependent Variable	Independent Variables X1	X2	X3	X4	R-Squared R2
Time	Total Barges	---	---	---	0.060568
Time	Full Barges	---	---	---	0.060558
Time	Horsepower	---	---	---	0.012500
Time	Discharge	---	---	---	0.010446
Time	Night/Day	---	---	---	0.010000
Time	Total Barges	Discharge	---	---	0.070505
Time	Total Barges	Horsepower	---	---	0.119261
Time	Total Barges	Night/Day	---	---	0.066777
Time	Total Barges	Discharge	Horsepower	---	0.125651
Time	Total Barges	Horsepower	Night/Day	---	0.124078
Time	Total Barges	Night/Day	Discharge	---	0.076112
Time	Total Barges	Discharge	Horsepower	Night/Day	0.130074
Time	Full Barges	Discharge	---	---	0.075130
Time	Full Barges	Horsepower	---	---	0.099746
Time	Full Barges	Night/Day	---	---	0.066229
Time	Full Barges	Discharge	Horsepower	---	0.112071
Time	Full Barges	Horsepower	Night/Day	---	0.104382
Time	Full Barges	Night/Day	Discharge	---	0.080032
Time	Full Barges	Discharge	Horsepower	Night/Day	0.116091
Time	Horsepower	Night/Day	---	---	0.019941
Time	Night/Day	Discharge	---	---	0.017544
Time	Discharge	Horsepower	---	---	0.021452
Time	Night/Day	Discharge	Horsepower	---	0.028279

UPBOUND TRAFFIC EXCLUDING DATA THAT VARIED MORE THAN 1 STANDARD DEVIATION FROM THE MEAN ELAPSED TRAVEL TIME OF THE PMS DATA IN 1986

Dependent Variable	Independent Variables X1	X2	X3	X4	R-Squared R2
Time	Total Barges	---	---	---	0.084854
Time	Full Barges	---	---	---	0.080669
Time	Horsepower	---	---	---	0.022381
Time	Discharge	---	---	---	0.016309
Time	Night/Day	---	---	---	0.010000
Time	Total Barges	Discharge	---	---	0.100477
Time	Total Barges	Horsepower	---	---	0.178781
Time	Total Barges	Night/Day	---	---	0.090808
Time	Total Barges	Discharge	Horsepower	---	0.188669
Time	Total Barges	Horsepower	Night/Day	---	0.183019
Time	Total Barges	Night/Day	Discharge	---	0.106001
Time	Total Barges	Discharge	Horsepower	Night/Day	0.192659
Time	Full Barges	Discharge	---	---	0.103074
Time	Full Barges	Horsepower	---	---	0.144789
Time	Full Barges	Night/Day	---	---	0.086313
Time	Full Barges	Discharge	Horsepower	---	0.163561
Time	Full Barges	Horsepower	Night/Day	---	0.149174
Time	Full Barges	Night/Day	Discharge	---	0.108128
Time	Full Barges	Discharge	Horsepower	Night/Day	0.167501
Time	Horsepower	Night/Day	---	---	0.029857
Time	Night/Day	Discharge	---	---	0.023731
Time	Discharge	Horsepower	---	---	0.036123
Time	Night/Day	Discharge	Horsepower	---	0.043164

* Elapsed time indicates the time of travel from Lock and Dam 5A to Lock and Dam 5.

Table 7 - WILDS BEND regression analysis results *

DOWNBOUND TRAFFIC ANALYZING ALL DATA FROM PMS DATA IN 1986 *

Dependent Variable	Independent Variables X1	X2	X3	X4	R-Squared R2
Time	Total Barges	---	---	---	0.000274
Time	Full Barges	---	---	---	0.000018
Time	Horsepower	---	---	---	0.000020
Time	Discharge	---	---	---	0.010000
Time	Night/Day	---	---	---	0.000890
Time	Total Barges	Discharge	---	---	0.010894
Time	Total Barges	Horsepower	---	---	0.000303
Time	Total Barges	Night/Day	---	---	0.001162
Time	Total Barges	Discharge	Horsepower	---	0.011092
Time	Total Barges	Horsepower	Night/Day	---	0.001180
Time	Total Barges	Night/Day	Discharge	---	0.011612
Time	Total Barges	Discharge	Horsepower	Night/Day	0.011836
Time	Full Barges	Discharge	---	---	0.011032
Time	Full Barges	Horsepower	---	---	0.000025
Time	Full Barges	Night/Day	---	---	0.000908
Time	Full Barges	Discharge	Horsepower	---	0.011486
Time	Full Barges	Horsepower	Night/Day	---	0.000922
Time	Full Barges	Night/Day	Discharge	---	0.011747
Time	Full Barges	Discharge	Horsepower	Night/Day	0.012238
Time	Horsepower	Night/Day	---	---	0.000919
Time	Night/Day	Discharge	---	---	0.011611
Time	Discharge	Horsepower	---	---	0.011074
Time	Night/Day	Discharge	Horsepower	---	0.011770

DOWNBOUND TRAFFIC EXCLUDING DATA THAT EXCEEDED 6 HOURS OF ELAPSED TRAVEL TIME FROM PMS DATA IN 1986

Dependent Variable	Independent Variables X1	X2	X3	X4	R-Squared R2
Time	Total Barges	---	---	---	0.107665
Time	Full Barges	---	---	---	0.115284
Time	Horsepower	---	---	---	0.006732
Time	Discharge	---	---	---	0.026029
Time	Night/Day	---	---	---	0.000787
Time	Total Barges	Discharge	---	---	0.119640
Time	Total Barges	Horsepower	---	---	0.120674
Time	Total Barges	Night/Day	---	---	0.108527
Time	Total Barges	Discharge	Horsepower	---	0.128761
Time	Total Barges	Horsepower	Night/Day	---	0.121859
Time	Total Barges	Night/Day	Discharge	---	0.120733
Time	Total Barges	Discharge	Horsepower	Night/Day	0.130113
Time	Full Barges	Discharge	---	---	0.137003
Time	Full Barges	Horsepower	---	---	0.126679
Time	Full Barges	Night/Day	---	---	0.116136
Time	Full Barges	Discharge	Horsepower	---	0.134985
Time	Full Barges	Horsepower	Night/Day	---	0.127819
Time	Full Barges	Night/Day	Discharge	---	0.128084
Time	Full Barges	Discharge	Horsepower	Night/Day	0.136297
Time	Horsepower	Night/Day	---	---	0.007368
Time	Night/Day	Discharge	---	---	0.027153
Time	Discharge	Horsepower	---	---	0.034622
Time	Night/Day	Discharge	Horsepower	---	0.035554

DOWNBOUND TRAFFIC EXCLUDING DATA THAT VARIED MORE THAN 1 STANDARD DEVIATION FROM THE MEAN ELAPSED TRAVEL TIME OF THE PMS DATA IN 1986

Dependent Variable	Independent Variables X1	X2	X3	X4	R-Squared R2
Time	Total Barges	---	---	---	0.162109
Time	Full Barges	---	---	---	0.170592
Time	Horsepower	---	---	---	0.005761
Time	Discharge	---	---	---	0.047721
Time	Night/Day	---	---	---	0.000728
Time	Total Barges	Discharge	---	---	0.185884
Time	Total Barges	Horsepower	---	---	0.190246
Time	Total Barges	Night/Day	---	---	0.162680
Time	Total Barges	Discharge	Horsepower	---	0.205967
Time	Total Barges	Horsepower	Night/Day	---	0.190521
Time	Total Barges	Night/Day	Discharge	---	0.186226
Time	Total Barges	Discharge	Horsepower	Night/Day	0.206140
Time	Full Barges	Discharge	---	---	0.194122
Time	Full Barges	Horsepower	---	---	0.194887
Time	Full Barges	Night/Day	---	---	0.171163
Time	Full Barges	Discharge	Horsepower	---	0.211363
Time	Full Barges	Horsepower	Night/Day	---	0.195187
Time	Full Barges	Night/Day	Discharge	---	0.194466
Time	Full Barges	Discharge	Horsepower	Night/Day	0.211551
Time	Horsepower	Night/Day	---	---	0.006630
Time	Night/Day	Discharge	---	---	0.048089
Time	Discharge	Horsepower	---	---	0.055849
Time	Night/Day	Discharge	Horsepower	---	0.056330

* Elapsed time indicates the time of travel from Lock and Dam 5 to Lock and Dam 5A.

PROPOSED ALTERNATIVES

The alternatives analysis is described in the main report. The alternatives are: 1) do nothing; 2) channel cutoff; 2A) channel cutoff; 3) restore Paps Slough; 4) overdredging Betsy Slough; 5) channel structures, Iowa Vanes; and 6) revised operation plan. Table 8 outlines the alternatives from a comparative point of view. The six alternatives are evaluated in Appendix E in terms of their economic feasibility and cost effectiveness (table 17).

BENEFIT ANALYSIS

The benefit-cost analysis has been developed considering four benefit categories. These four categories are: safety, transportation savings, savings to railroad in annual maintenance, and decreased dredging costs.

Benefits to the railroad grade by not having to place as much riprap were assigned to alternative 3 (Paps Slough) and alternative 5 (Iowa Vanes). The other alternatives were not considered to alleviate the erosion damage to the railroad grade riprap.

Dredging cost savings was the fourth class of benefits. These estimates of dredging cost savings were based on engineering judgment. As indicated in the benefit-cost table, the structural alternative for Betsy Slough is the only cost effective alternative. This alternative would also be justified solely as a maintenance cost reduction measure using only dredging cost as benefits. Using only the dredging cost savings as a benefit yields a benefit-cost ratio of 1.59.

METHODOLOGY

This section describes the methodology used to evaluate the other benefit categories. For illustrative purposes, the calculations used to display the methodology are for the selected alternative.

Safety benefits for the project represent avoided navigation disruptions resulting from river traffic delays under current conditions. These benefits are computed using the lesser of delay costs or system transportation savings. Traffic diversion to an alternate mode of transport would occur when delay costs exceeded system transportation savings plus the cost of unloading the commodities. Traffic diversion has not been considered in this analysis.

Safety benefits for this analysis were computed on a unit (per ton) basis. Based on the average tonnage passing through lock 5 for the most recent 5-year (1982-1986) period, commodities were placed in five groups: grain, coal, petroleum, chemicals, and other (representing 66 percent, 10 percent, 8 percent, 9 percent, and 7 percent of total commodity movements, respectively). Because the "other" category comprised only 7 percent of the 5 year traffic average, it was felt that five commodity groups would provide sufficient accuracy for the analysis. Commodity movements through lock 5A were converted into tons-per-hour movements by dividing 5-year average tonnage figures by the 5-year (1981-1986) average navigation season (6,394 day hours). Table 9 outlines these calculations.

Table 8 - Wilds Bend alternative comparison

Alt. No. Alternative	Description	Quantities cu.yds	Constr. Cost ($)	Ave. Ann. Dredging cu/yds	Dredging Reduct.(%) cu.yds	New Dredge Quantities cu.yds./yr.	New Ann. Drdg cat ($)
1. Do Nothing	No change in operation.	0	0	28,000	0	0	$140,000
2. Channel Cutoff	Excavate a 300 ft. channel 12 ft. below LCP, 6,200 ft long with 3:1 side slopes. The cut will parallel the railroad on the Wisconsin side.	597,333	2,986,665	28,000	9,800(35%)	18,200	91,000
2A. Channel Cutoff	Same as above except for the location and length. Length will be about 5,200 ft. The cut will be curved and about 1,600 ft off the railroad.	618,286	3,091,430	28,000	7,000(25%)	21,000	105,000
3. Restore Pacs Slough	Restore this channel as the main channel. The cross section of alternative 2 will be used for a length of about 8,500 ft.	517,944	2,589,720	28,000	9,800(35%)	18,200	91,000
4. Overdredging Betsy Slough	Dredge the 8,000 ft. channel to a 400 to 450 ft. wide channel bottom and 3:1 side slopes.	250,000	1,250,000	30,000	0	30,000	150,000
5. Channel Structures	Training structures in Betsy Slough (Iowa Vanes).	8,224sf	164,480($20)	28,000	19,600(70%)	8,400	42,000
6. Revised Operation Plan	Raise the flat pool elevation by 1 ft.	0	0	28,000	0	28,000	140,000

NOTES:

Dredgings (1956 thru 1985)

	River Mile	Cu.yds/30yrs	Ave cu.yds/yr	# of Dredgings	Equipment (# of dredgings) Thompson	Hauser	contract	Depth below LCP
Head of Betsy Slough	731.0 to 732.0	485,300	16,177	16	8	7	1	11,12 & 13'
Wilds Bend	730.2 to 730.7	388,300	12,960	*15	9	4	0	11,12 & 13'
TOTALS:		674,100	29,137	*31	17	11	1	

* No Equipment listed for 1971 and 1972

Table 9 - 5-year average tonnage

Commodity	Tonnage	Navigation Season Hours	Tons/Hour
Grain	8,800,100	6,394	1,376
Coal	1,312,000	6,394	205
Petroleum	1,061,400	6,394	166
Chemicals	1,282,600	6,394	201
Other	902,000	6,394	141

Hourly delay costs per ton, transportation rates per ton, by commodity, were derived from the Upper Mississippi River Basin Commission Master Plan for the Management of the Upper Mississippi River System. All values were updated to October 1986 price levels using the inland-shallow draft navigation index, which is based on the railroad freight rate index. The total cost per hour is $59.50 for all the commodities (table 10).

Table 10 - Hourly assessment

Commodity	Tons/Hour	Delay Cost Tons/Hour	Cost/Hour
Grain	1,376	0.025	$34.41
Coal	205	0.023	$4.72
Petroleum	166	0.050	$8.30
Chemicals	201	0.044	$8.83
Other	141	0.023	$3.24
Total Commodity Costs Per Hour			$59.50

The total number of barges moved through Lock and Dam 5A is 1,198. This is an average of 8.7 barges per tow throughout 1986 (table 11).

Table 11 - Average tow size

	Number of Barges Upbound	Number of Barges Downbound	Total	Average Number of Barges per Tow
Barges	5,177	5,300	10,477	8.7454
TOTAL Number of Tows			1,198	

The number of barges is listed by month in table 12 and divided into 2 groups, regular and integrated. This separation was determined by analyzing the barge types in the PMS data. The cost of each type of barge is from EC 105-2-170 (1).

Table 12 - Type of barges, Lock and Dam 5A (from 1986 PMS data)

Month	Number of Barges Regular	Integrated
March	211	185
April	982	54
May	1,248	1,173
June	1,282	57
July	1,516	111
August	1,933	96
September	1,147	94
October	903	48
November	1,007	64
December	0	1
Sub-Total	10,229	1,883
Total Barges		12,112
Percent of Cost	0.845	0.155
Cost of Barge Per Hour	\$3.81	\$16.06
Cost Per Hour	\$3.22	\$2.49
Cost Per Hour for Barges		\$5.71

The tow costs of operation per hour are summarized in table 13 by horsepower. This shows a total cost of \$268.00 per hour per tow which includes all fixed and variable costs from EC 105-2-170. A total of all the costs per hour is the commodity costs (\$59.50) plus the barge costs (\$50.00) plus the tow costs (\$268.00) for a total of \$377.50 per hour of delay costs.

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(1) EC 1105-2-170 was the appropriate guidance at the time of the analysis.

Table 13 - Weighted averages of horsepower for Lock and Dam 5A traffic

Horsepower Ranges	Number of Tows Upbound	Number of Tows Downbound	Total Tows	Weighted Average	Total Hourly Fixed Costs	Weighted Fixed Costs
400-600	22	22	44	0.0367	$67.88	$2.49
800-1000	4	6	10	0.0083	$87.42	$0.73
1200	10	7	17	0.0142	$116.50	$1.65
1400-1600	4	5	9	0.0075	$129.88	$0.98
1800-2000	47	51	98	0.0818	$167.00	$13.66
2200-2400	23	21	44	0.0367	$185.38	$6.81
2800-3400	71	73	144	0.1202	$232.63	$27.96
4000-4400	185	191	376	0.3139	$277.00	$86.94
5000-6000	206	210	416	0.3472	$328.25	$113.98
6100-7000	21	19	40	0.0334	$383.25	$12.80
7100-8000	0	0	0	0.0000	$403.21	$0.00
8100-9000	0	0	0	0.0000	$443.35	$0.00
10000	0	0	0	0.0000	$501.04	$0.00
TOTAL NUMBER OF TOWS			1198	Dollars Lost Per Hour		$268.00

Analyzing the grounding report data in table 5 to determine the average annual benefits due to groundings is summarized in table 14. The total hours of delay is calculated and divided by the number of vessels in this study to determine the average delay time per grounding. The average number of groundings is actually 3.8 per year, but according to the lockmaster at Lock and Dam 5A, only 75% of all groundings are reported so 5 groundings per year is the assumed average. The average delay time per grounding times the average number of groundings per year determines the average hours of delay per year. The average hours of delay per year times the cost per hour gives a total of $7,512.82 in average annual benefits for this assumption.

Table 14 - Average delay time per year (Using data from Table 5)

Year	Month	Date	Vessel Id. Number	How Long Hours	How Long Minutes
1986	August	5	630998	1	20
1986	November	1	617935	0	25
1986	November	3	287337	4	30
1985	May	29	533682	2	0
1985	June	10	602461	2	45
1984	June	10	558474	8	25
1984	June	12	602459	14	45
1984	July	19	602136	0	15
1984	July	28	272877	2	0
1984	July	31	628776	7	0
1984	November	26	288017	0	22
Total Delay Time				40	227

Total Minutes of Delay	2,627.00
Total Hours of Delay	43.78
Average Delay Time Per Grounding	3.98
Average Number of Delays Per Year	5
Average Delay Time Per Year	19.90
Cost Per Hour of Delay	$377.50
Total Average Annual Benefits	$7,512.82

As stated earlier, no predictive equation could be developed for the travel time of tows following reported groundings, and alternative methodology was developed. Transportation savings were evaluated by assigning additional delay costs to those vessels which exceeded the "normal" travel time between locks 5 and 5A. Normal travel time is defined as any time in excess of one standard deviation from the mean travel time. This method assumes that all deviations in excess of "normal" are delayed either as the result of groundings, other vessel groundings, or tying off to avoid running into another tow. The upbound vessels had a mean of 1.95 hours of elapsed time, a standard deviation of 1.24 hours of elapsed time, and a maximum normal travel time of 3.19 hours of elapsed time. The downbound vessels had a mean of 1.51 hours of elapsed time, a standard deviation of 2.08 hours of elapsed time, and a maximum normal travel time of 3.59 hours of elapsed time.

A further study includes only the vessels of the entire sample group of which their elapsed time exceeds the one standard deviation of the 'normal' elapsed time. The regression analysis described earlier does not indicate that any one or combination of independent variables would explain why these elapsed times are as they are. It is assumed that these delays are due to unreported groundings. These calculations are summarized for upbound data in table 15, and downbound date in table 16. Benefits of prevented delays total $40,361.80.

Table 15 - Upbound traffic delays - 1986

Elapsed Time	Number of Tows in this range of Time	Hours in excess of the 'Normal' elapsed time	Total Hours Delayed in 1986
3.25	8	0.0600	0.48
3.50	8	0.3100	2.48
3.75	2	0.5600	1.12
4.00	6	0.8100	4.86
4.25	3	1.0600	3.18
4.50	1	1.3100	1.31
4.75	2	1.5600	3.12
5.00	0	1.8100	0.00
5.25	1	2.0600	2.06
5.50	0	2.3100	0.00
5.75	2	2.5600	5.12
6.00	0	2.8100	0.00
6.25	0	3.0600	0.00
6.50	0	3.3100	0.00
6.75	0	3.5600	0.00
7.00	0	3.8100	0.00
7.25	0	4.0600	0.00
7.50	0	4.3100	0.00
7.75	0	4.5600	0.00
8.00	0	4.8100	0.00
8.25	0	5.0600	0.00
8.50	0	5.3100	0.00
8.75	0	5.5600	0.00
9.00	0	5.8100	0.00
9.25	0	6.0600	0.00
9.50	0	6.3100	0.00
9.75	0	6.5600	0.00
10.00	0	6.8100	0.00
10.00	3	6.8100	20.43

Total Tows	36	
Tows Deleted	1	

Tows Considered	35	
Hours of Delay for 1986		44.16
Average Hours of Delay Per Tow		1.23
Total Hours Considered		42.93
Costs Per Hour of Delay		$377.50

Total Annual Costs, 1986		$16,207.35
		================

Table 16 - Downbound traffic delays - 1986

Elapsed Time	Number of Tows in this range of Time	Hours in excess of the 'Normal' elapsed time	Total Hours Delayed in 1986
3.75	1	0.16	0.16
4.00	0	0.41	0.00
4.25	2	0.66	1.32
4.50	0	0.91	0.00
4.75	1	1.16	1.16
5.00	1	1.41	1.41
5.25	1	1.66	1.66
5.50	0	1.91	0.00
5.75	0	2.16	0.00
6.00	1	2.41	2.41
6.25	1	2.66	2.66
6.50	1	2.91	2.91
6.75	0	3.16	0.00
7.00	2	3.41	6.82
7.25	1	3.66	3.66
7.50	0	3.91	0.00
7.75	0	4.16	0.00
8.00	0	4.41	0.00
8.25	0	4.66	0.00
8.50	1	4.91	4.91
8.75	0	5.16	0.00
9.00	0	5.41	0.00
9.25	0	5.66	0.00
9.50	0	5.91	0.00
9.75	0	6.16	0.00
10.00	0	6.41	0.00
10.00	6	6.41	38.46

Total Tows	19
Tows Deleted	1
Tows Considered	18

Hours of Delay for 1986	67.54
Average Hours of Delay Per Tow	3.55
Total Hours Considered	63.99
Costs Per Hour of Delay	$377.50
Total Annual Costs, 1986	$24,154.45

A summary of annual benefits attributable to the alternatives, as well as the annual cost, is provided in table 17. Alternative 5 is the only economically viable plan, with a benefit-cost ratio of 2.1 and average annual net benefits of $66,400.

Table 17 - Annual benefits and costs of the various alternatives

Alternative Number	Railroad Benefits	Reduced Dredging Costs	Safety Benefits	Delays > 'Normal' Elapsed Times	Total Annual Benefits	Total Annual Costs	Benefit/ Cost/ Ratio
1	0	0	0	0	0	$140,000	0
2	0	$49,000	$7,500	$40,400	96,900	446,400	0.22
2 A	0	35,000	7,500	40,400	82,900	472,900	0.18
3	$30,000	49,000	0	0	79,000	399,000	0.2
4	0	0	0	0	0	299,000	0
5	30,000	98,000	0	0	$128,000	61,600	2.1
6	0	0	0	0	0	140,000	0

APPENDIX C

HYDRAULICS AND HYDROLOGY

TABLE OF CONTENTS

APPENDIX C

HYDRAULICS

The Wild's Bend Channel Improvement Reconnaissance Report, October 1985, recommended a more detailed investigation of four of the seven alternatives studied for that report. The four alternatives carried forward included two channel cut-offs, using a different channel of the Mississippi River (Pap Slough) and using structural means to improve the existing channel. The three alternatives which were dropped from further consideration were the do nothing alternative, overdredging of Betsy Slough and a revised operating plan for L/D 5A. The area of concern in this study includes two frequent dredging locations, Wilds Bend and Betsy Slough. These two areas are relatively sharp bends with ever present point bars that tend to make the navigation channel extremely narrow considering the severity of these bends. In addition to the impacts of frequent maintenance dredging, the combination of three sharp bends (the two already mentioned and a third just downstream) make this a difficult area for commercial navigation. This appendix examines the various alternatives in terms of their impact upon river hydraulics.

POOL 5A PRESENT OPERATIONS

Pool 5A is a part of the Mississippi River 9-foot channel project that extends from above the Falls of St. Anthony in Minneapolis, Minnesota, to below the mouth of the Missouri River near St. Louis, Missouri. The lock and dam (L/D) 5A project was placed in operation in 1936.

The primary purpose of L/D 5A and the 12 other navigation dams in the St. Paul District is to maintain a minimum channel depth of 9 feet for navigation. To do this, project pool elevations must be maintained at the primary control points. Operation of the dams is required during low and moderate flows on the Mississippi River but is not necessary during high flows. The movable dams must be removed from the water before flood stages are reached. Except for the water that goes into valley storage as the inflows increase, all inflow must be discharged.

Because pool 5A is so short (9.25 miles), the theoretical control point is only 1.88 miles downstream of L/D 5. Thus, the tailwater gage at L/D 5 is used for the primary control point, thereby eliminating the need for a gage at the theoretical point (see plates C-1 and C-2).

Elevation 651.0 is maintained at the primary control point by the operation of L/D 5A until the discharge at the dam exceeds 24,000 cfs. At this discharge, the maximum allowable drawdown at the dam of 1.0 foot to elevation 650.0 occurs, and the regulation of the pool is shifted to secondary control at the dam.

As the discharge increases above 24,000 cfs, the pool level at the dam is held at elevation 650.0, and the stage at all other points in the pool is allowed to rise. Also, as the discharge increases, the operating head at the dam decreases. When the discharge reaches 59,000 cfs, the operating head at the dam will be reduced to about 0.5 of a foot, and all the gates are then raised clear of the water. As the flow increases above 59,000 cfs, open river conditions are in effect, and the dam is out of control. On the recession, the gates are returned to the water when the pool at the dam drops to elevation 650.0, the secondary control elevation. This elevation will be reached at a flow of 59,000 cfs, and secondary control elevation is maintained at the dam until the water level at the primary control point drops to project pool elevation 651.0, at a flow of 24,000 cfs. At the latter flow, control of the pool is returned to the primary control point, and as the discharge decreases the water surface at the dam will rise, and the drawdown will decrease.

The lock miter gate motors are removed when the water surface at the dam reaches 657.5 (approximately 143,000 cfs) and navigation ceases. The lock miter gate motors are removed at L/D 6 at approximately 126,000 cfs, at L/D 5 at approximately 159,000 cfs and at L/D 4 at approximately 131,000 cfs.

ALTERNATIVES CONSIDERED

Two-dimensional computer models of Pool 5A were generated to represent existing conditions and three alternative conditions; alternative 2 - the straight cut-off channel, alternative 2-A - the modified cut-off channel, and alternative 3 - the restoration of Pap Slough as the navigation channel. The use of structural means to improve the existing navigation channel - alternative 5 - could not be computer modeled for reasons discussed in a later section about alternative 5. (See Plate C-3 for plan view of alternatives.) All models utilized the same finite element grid (Plate C-4). The changes to the grid for the different models were accomplished by changing nodal elevations in the geometry model and changing "n" values and eddy diffusion coefficients in the hydrodynamic model.

EXISTING CONDITIONS MODEL

The existing navigation channel parallels the railroad tracks along the Wisconsin bank from L/D 5A (UMR mile 728.5) to UMR mile 729.5, then a series of 3 sharp bends takes it away from and then back to the railroad tracks at mile 731.3. These three bends make up the area known as Betsy Slough and Wilds Bend. From mile 731.3, the channel again parallels the railroad tracks past the town of Fountain City to mile 733.4 where it begins meandering over to the Minnesota side and L/D 5.

The existing conditions model consists of 3,011 nodes making up 903 elements which cover the water area of Pool 5A. The elements of the model are divided into 10 distinctive areas. These areas are as follows:

Type	Description	"n" value	Eddy Diffusion Coefficient
1	Navigation Channel	.022	75
2	Wing dam at head of Betsy Slough	.022	75
3	Alt. 2 channel	.045	150
4	Alt. 2A channel	.045	150
5	Pap Slough	.030	100
6	Spillways	.025	200
7	Wing dam at head of Pap Slough	.035	250
8	Backwater Lakes	.045	150
9	Shallow backwater channels	.035	150
10	Major Sloughs, Bays	.035	150

No attempt was made to differentiate between the vegetation clogged areas (emergent or submerged) from the clear channels in the backwater lakes such as Polander Lake. Instead, the "n" value chosen for these areas was intended to be an average value. Inflow boundaries are along L/D 5 and across Fountain City Bay above the channel from Devil's Cut. Outflow boundaries are L/D 5A and the 1,000-foot long spillway in the western end of L/D 5A's dike.

The existing conditions model was not extremely accurate in reflecting measured flow distribution between the navigation channel and the numerous side channels. Measured flow in Betsy Slough was approximately 56% of the total flow on the day of measurement, while in the model, the discharge in Betsy Slough was computed to be between 59-65% of the total flow. In Pap Slough the measured flow was approximately 16% of the total versus a computed 19% of the total in the model. It cannot be completely determined whether there is an error in the model or in the measurement as only one measurement was obtained in each channel. However, the model was generally quite accurate in predicting the actual water surface at the upstream end of the model (generally less than 0.1 ft.) for the range of discharges modeled. Discharge values ranged from 47,700 cfs (the lowest discharge while discharge measurements were being made) to 86,100 cfs, at which point the water surface level at the upstream end began to diverge from the recorded water surface level for similar discharge. In Pool 5A, the channel banks in the upper reaches are relatively low and do not contain the flow at moderately high discharges. Since the model was designed to contain all flow within the normal banks, the model diverges from the actual at that level.

ALTERNATIVE TWO

Alternative Two is a 6,200 foot long cut-off channel dredged parallel to the railroad tracks from UMR mile 729.5 to approximately UMR mile 731.3 through a shallow backwater and a short stretch of wooded land. The channel is to be dredged to 12 feet below normal pool with a 300 foot wide bottom and 3 horizontal to 1 vertical side slopes (3H:1V). This alternative would shorten the navigation channel by approximately 3,300 feet.

The model was modified to represent this alternative by changing the nodal elevations in the type 3 elements to 12-feet below LCP and by changing the "n"-values and the eddy diffusion coefficients to .022 and 75 respectively. These changes resulted in a lowering of the water surface and an increase in velocity above the cut-off channel.

As expected, the cut-off channel resulted in a lowered water surface upstream of the cut-off. The effect was most pronounced immediately upstream of the cut-off, but extended to the tailwater of L/D 5 (see Plates C-5 through C-9 and Tables 1 through 5). The lowered water surface means that velocities will be higher (velocities increased from 3.22 fps for existing conditions to 3.67

fps for this alternative at node 648 at the lowest flow level modeled) and the potential for scour through the cut-off and upstream will be increased with probable deposition of the scoured material downstream of the cut-off channel. In addition, the length of essentially straight channel from L/D 5A at UMR Mile 728.5 to upstream of Fountain City at UMR Mile 733.4 would probably introduce additional instability due to the natural meandering tendencies of rivers.

ALTERNATIVE TWO-A

Alternative Two-A is a longer cut-off channel approximately midway between the proposed alignment of alternative two and the existing channel. The bottom width of this channel would have to be between 350-400 feet. This channel would be approximately 2,000 feet shorter than the existing navigation channel and would increase the radius of all three bends which now exist in this reach.

Changes in the model were made by changing the nodal elevations, the "n"-values and eddy diffusion coefficients of the type 4 elements. This alternative also caused a lowering of the water surface upstream of the cut-off, although due to the length of the channel the reduction was not as great as it was for Alternative Two (see Plates C-10 through C-14 and Tables 1 through 5). Also, as in Alternative Two, the difference in the water surface between this alternative and the existing conditions increased as discharge increased. This alternative would also cause an increase in velocity above the cut-off channel with probable scour above and through the cut-off channel with probable increased deposition below the cut-off channel.

ALTERNATIVE THREE

Alternative Three would change the navigation channel from Betsy Slough to

Pap Slough (the boundary between the states of Minnesota and Wisconsin follows Pap Slough, indicating that at the time of statehood, it was considered the main channel) by dredging, removing the closing dam at the head of the slough and adding a closing dam across the head of Betsy Slough. Pap Slough has depths as great as 13-feet, but much of it is in the range of 4- to 6-feet deep that would have to be dredged to 12-feet. As with Alternative Two-A, the bottom width would have to be between 350-400 feet. This channel would not change the length of channel by any appreciable amount, but would substantially increase the radius of curvature of the first two bends. Conditions at the third bend might be improved by allowing better positioning of traffic coming out of the second bend.

The model was modified for this alternative by lowering all elevations through Pap Slough and raising the elevations along the closing dam at the head of Betsy Slough and making the corresponding changes to "n"-values and coefficients. Because this alternative dces not appreciably change the geometry of the river, the effects on water surface elevation and velocities are very minor (see Plates C-15 through C-19 and Tables 1 through 5). For this alternative, the computed flow through Betsy Slough initially drops to 50% of the total flow while the flow through Pap Slough rises to 30% of the total. Even though the amount of flow in Pap Slough is increased, the cross-sectional area is also larger and the velocities in both channels will be reduced. Eventually, as Pap Slough is maintained and Betsy Slough is allowed to silt in, these percentages will likely change until the majority of the flow is through Pap Slough. Until that time, depending on actual flow conditions, frequent maintenance dredging may be required.

RECOMMENDED PLAN - ALTERNATIVE FIVE

Alternative Five would improve the existing navigation channel by structural means to reduce dredging and allow for easier navigation. This alternative could not be computer modeled because it depends on changes in the secondary curre.ıts for its effectiveness, and the two-dimensional model relies on the average velocity in the two primary directions for all computations. The secondary current is present in all bends where the faster surface water tends to flow to the outside of the bend. Because the bank limits this outward flow of water, the water tends to "pile up". This super-elevation is most noticable on fast flowing streams with sharp bends, but even on the more placid rivers the effect can be measured. Gravity tries to balance the water surface and the water plunges to the bottom and crosses the river to the inside of the bend. The faster moving water on the outside of the bend scours the bank and the bottom and transports the sand towards the inside where it is dropped adding to the development of the point bar. The water reaches the surface and once more starts flowing across to the outside, initially replacing the water which has moved to the outside and then flowing toward the outside by centrifugal force.

A method has been developed to interfere with this secondary current. This method consists of a field of structures which have been termed "Iowa Vanes." Each vane is a relatively smooth sided vertical structure which extends from the existing bed elevation to a height of from 0.2 to 0.5 times the water depth. Within these height guidelines, the tops of all vanes would be at least 15 feet below LCP. The field consists of a double row of vanes extending from above the bend (minimum depth of 17 to 18 feet) through the bend. These structures are placed at a small angle to the flow to deflect the water near the bed toward the outside of the bend. This deflection is calculated to counteract the secondary current and maintain the current flow in the bend as if it were flowing in a gentle curve with no unbalanced forces instead of through a sharp bend. In physical model studies, after allowing the movable bed model to develop the normal point bar and deep outside channel within a bend, the placing of a series of vanes within the bend resulted in the scouring of the point bar and siltation within the deep outside channel until the bed form was nearly level (see Plate C-20). "Iowa Vanes" have been placed in two streams in Iowa, but to this point, they have not been placed in any large rivers. For this study, the physical characteristics of the vanes, such as height and length and the spacing of the field of vanes (from the river bank, between the rows of vanes and in the direction of flow) have been based on parameters developed from the physical model studies already conducted. However, in order to optimize these features, and to answer other questions, a physical model study based on this location is recommended.

The use of Iowa Vanes is expected to greatly reduce the need for dredging in this area. In addition to a reduction in dredging requirements and a wider navigable channel, by interfering with the secondary current, the boats transiting this reach will not have to steer as hard to act against the drift to the outside of the bend.

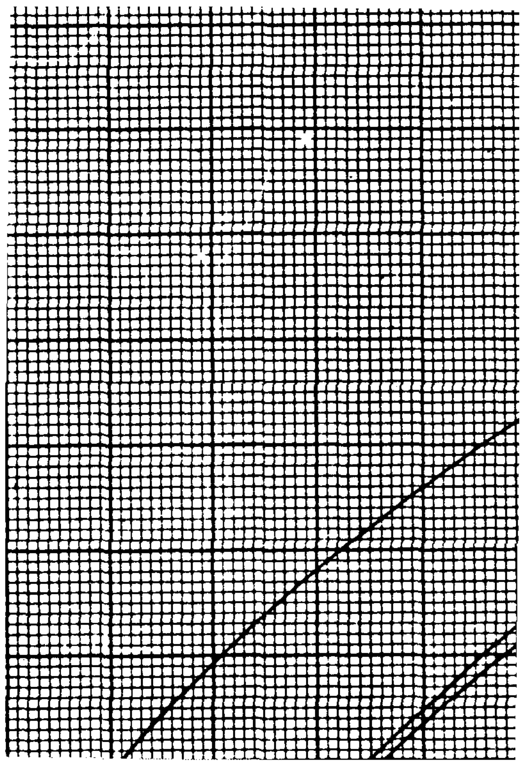
CONCLUSIONS AND RECOMMENDATION

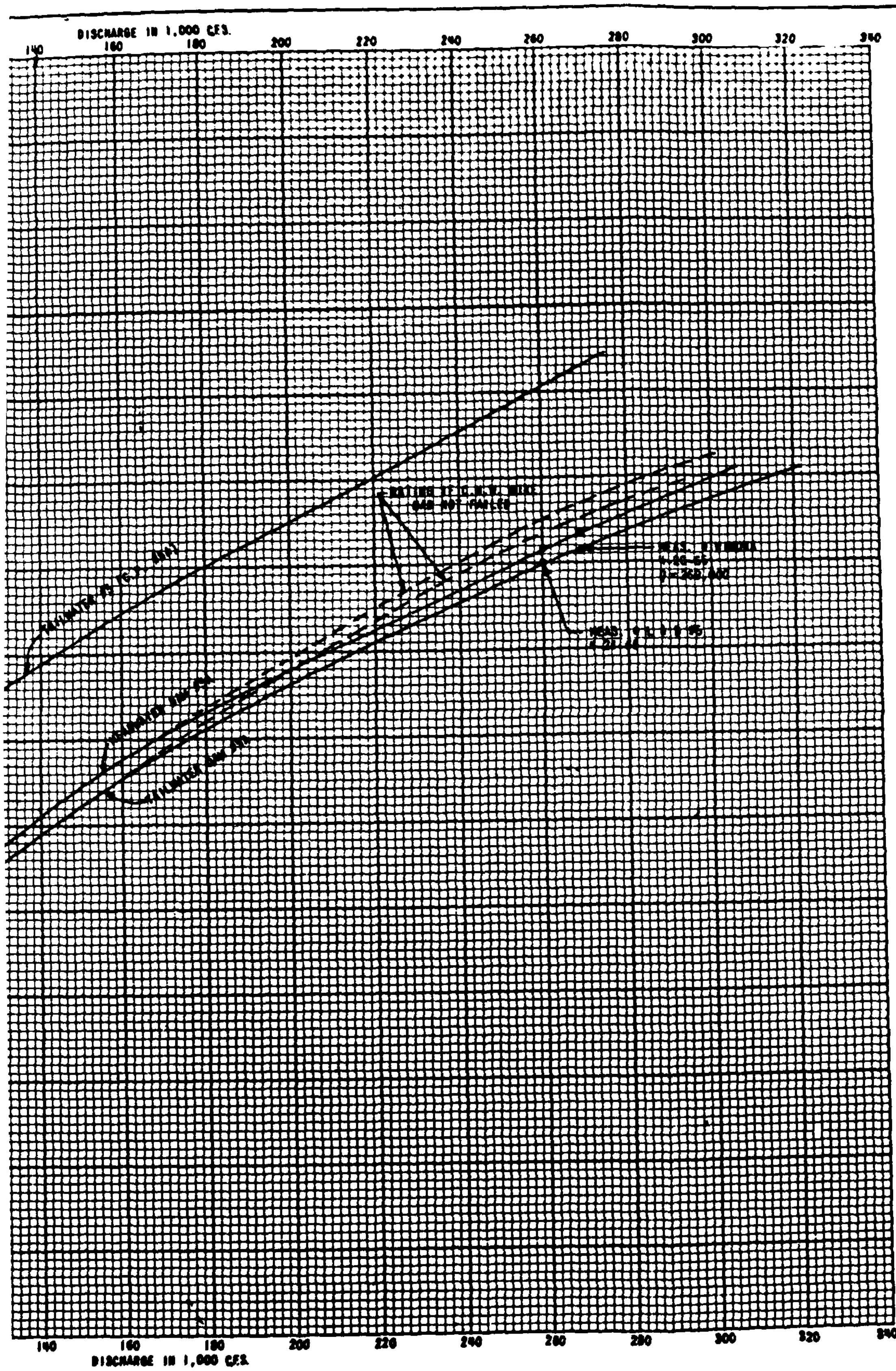
The two cut-off channel alternatives cause lowered water surface elevations and higher velocities in the navigation channel above the cut-off. The most likely result of these changes would be increased erosion and instability in the channel above the cut-offs and probable increased deposition below the new channel. After a period of time, it is possible that a new equilibrium may be attained, but this cannot be ascertained from the computer model study.

Alternative three seemingly has most of the advantages of the cut-off channels without the negative impacts. This alternative would enlarge the flow area by dredging through Pap Slough. Velocities will be reduced in both Betsy Slough and Pap Slough, probably resulting in deposition in both channels. Eventually, deposition in Betsy Slough will likely cause conditions in Pap Slough to become more like the existing conditions in Betsy Slough, but without the sharp bends that contribute to the point bar build-up that requires frequent dredging. Some dredging in Pap Slough will probably be required before stability is achieved.

Alternative Five is unproven and untested in large rivers. However, based on the results achieved in movable bed physical models and on the two small streams where they have been constructed, this alternative has the promise of numerous advantages including reduced dredging, reduced bank erosion, easier navigation and the aesthetic advantage that nothing would be visible. No adverse impacts have been identified.

Ranking the various alternatives in order of impact upon the hydraulics of the Mississippi River, Alternative Five has the least impact followed by Alternative Three, Alternative Two-A and finally Alternative Two with the greatest impact. From a hydraulic viewpoint either Alternative Five or Alternative Three is recommended, with a definite preference for Alternative Five.

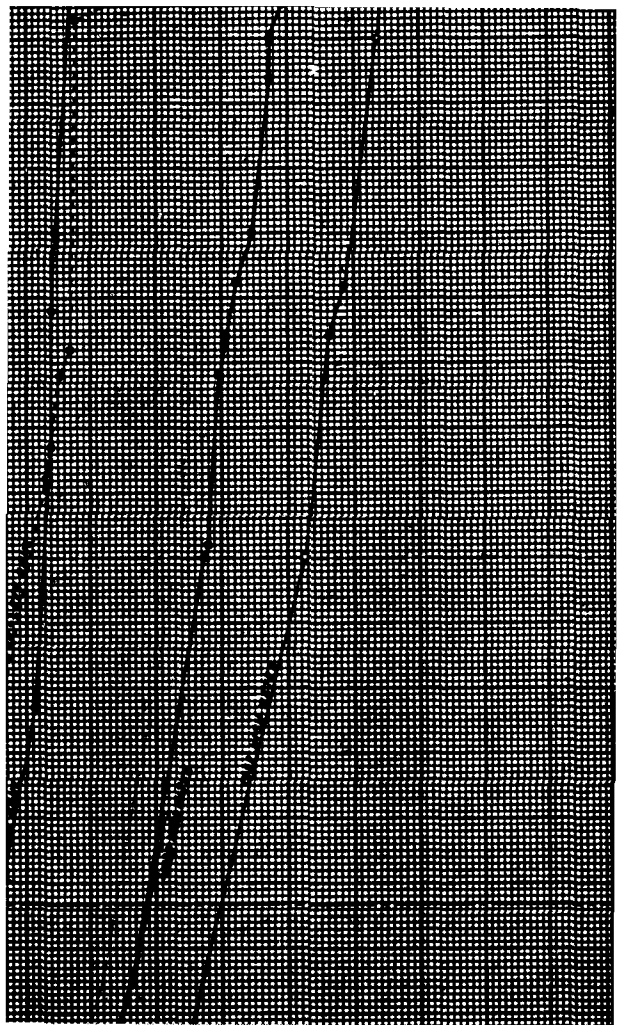




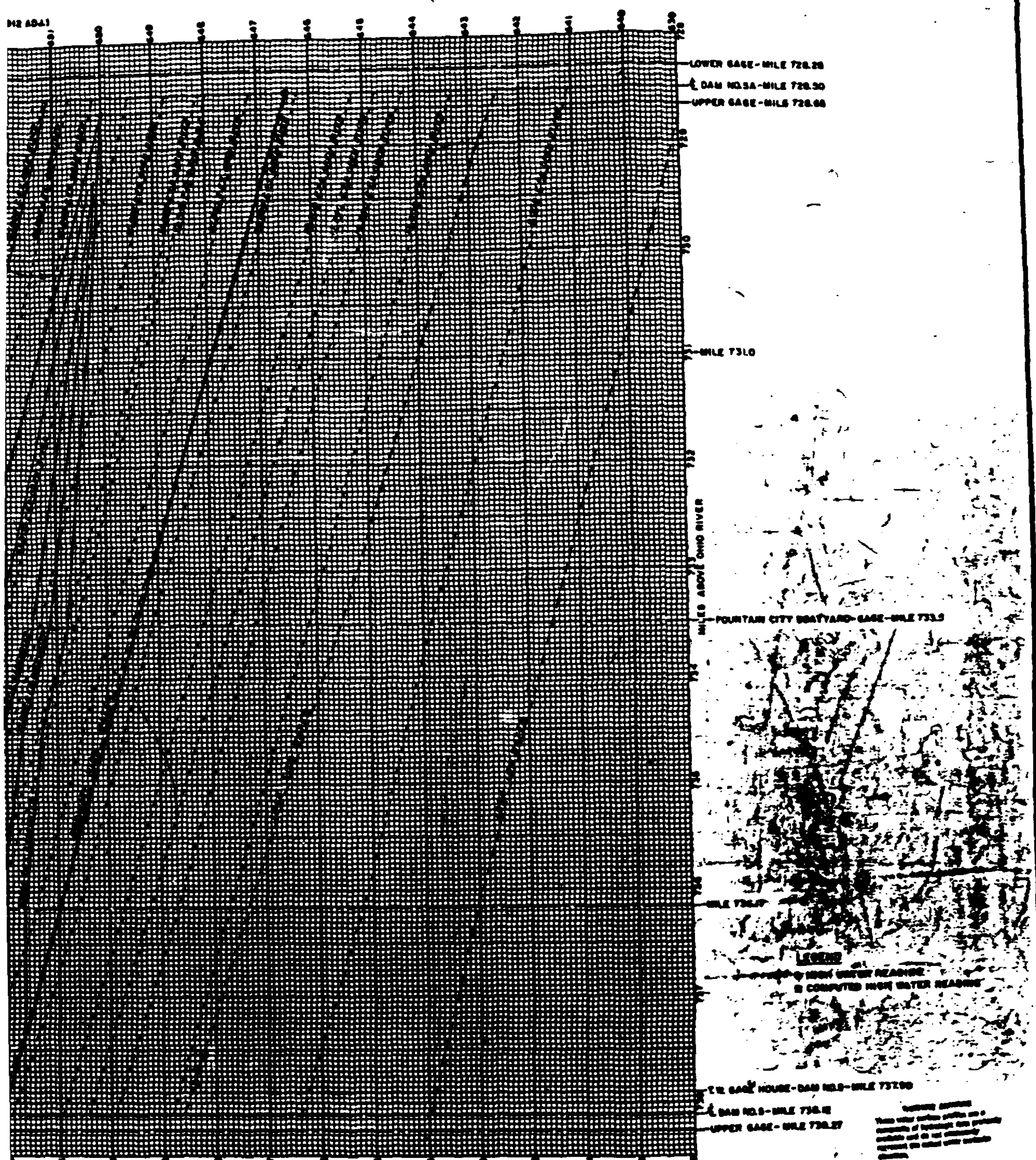
TAILWATER DAM #5 REVISED 5-3-1967

OPERATING CURVES
POOL NO. 5A
UPPER MISSISSIPPI RIVER
1966 DATA

PLATE C-1



U. S. ARMY



U. S. ARMY ENGINEER DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

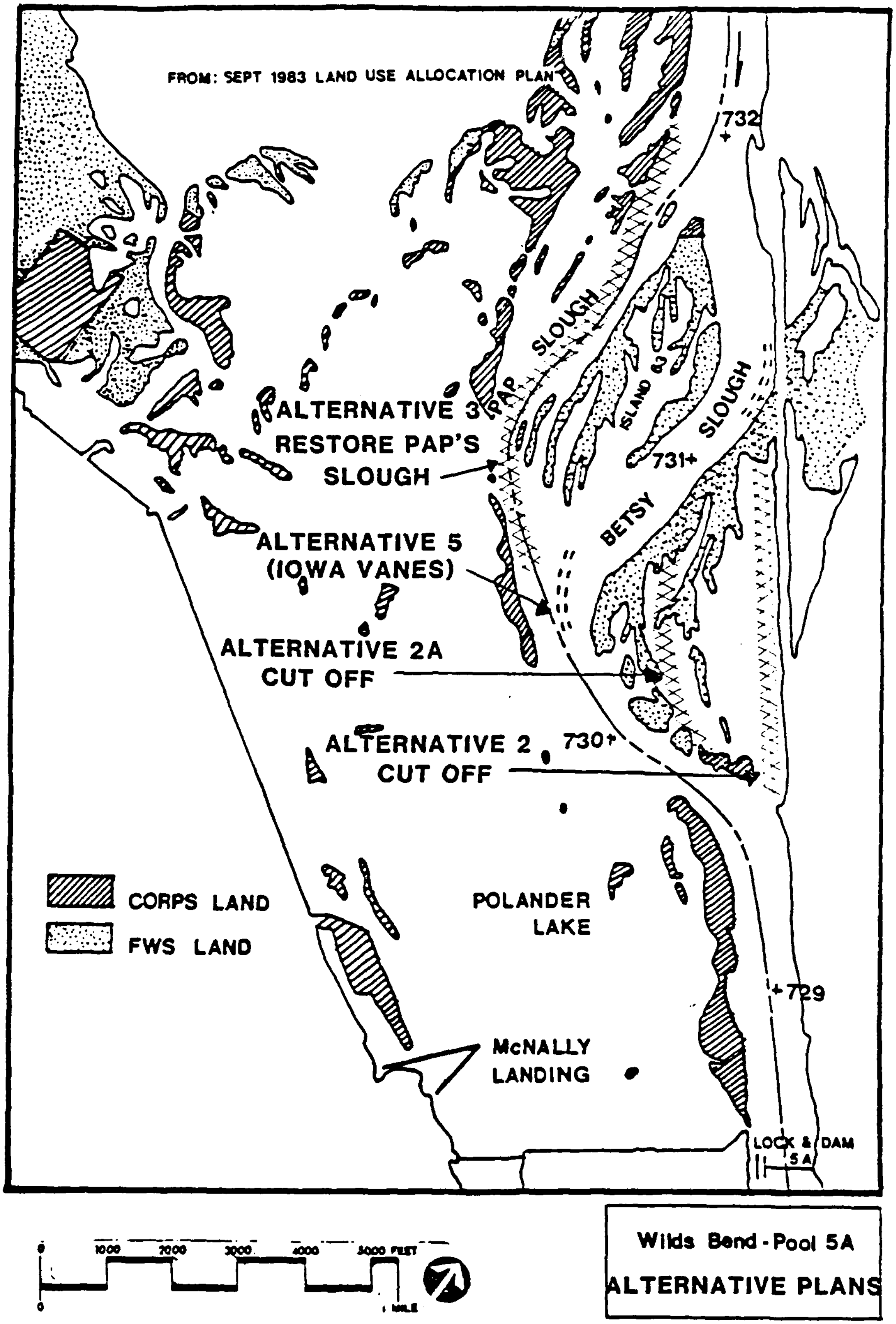
UPPER MISSISSIPPI RIVER
POOL NO. 5A
CONTROL & BACKWATER CURVES

H.E.H.
V.E.C.
H.E.H.
SUBMITTED BY:
APPROVED:
DECEMBER 1966
M-55A-14/2

25M,

PLATE C-2

2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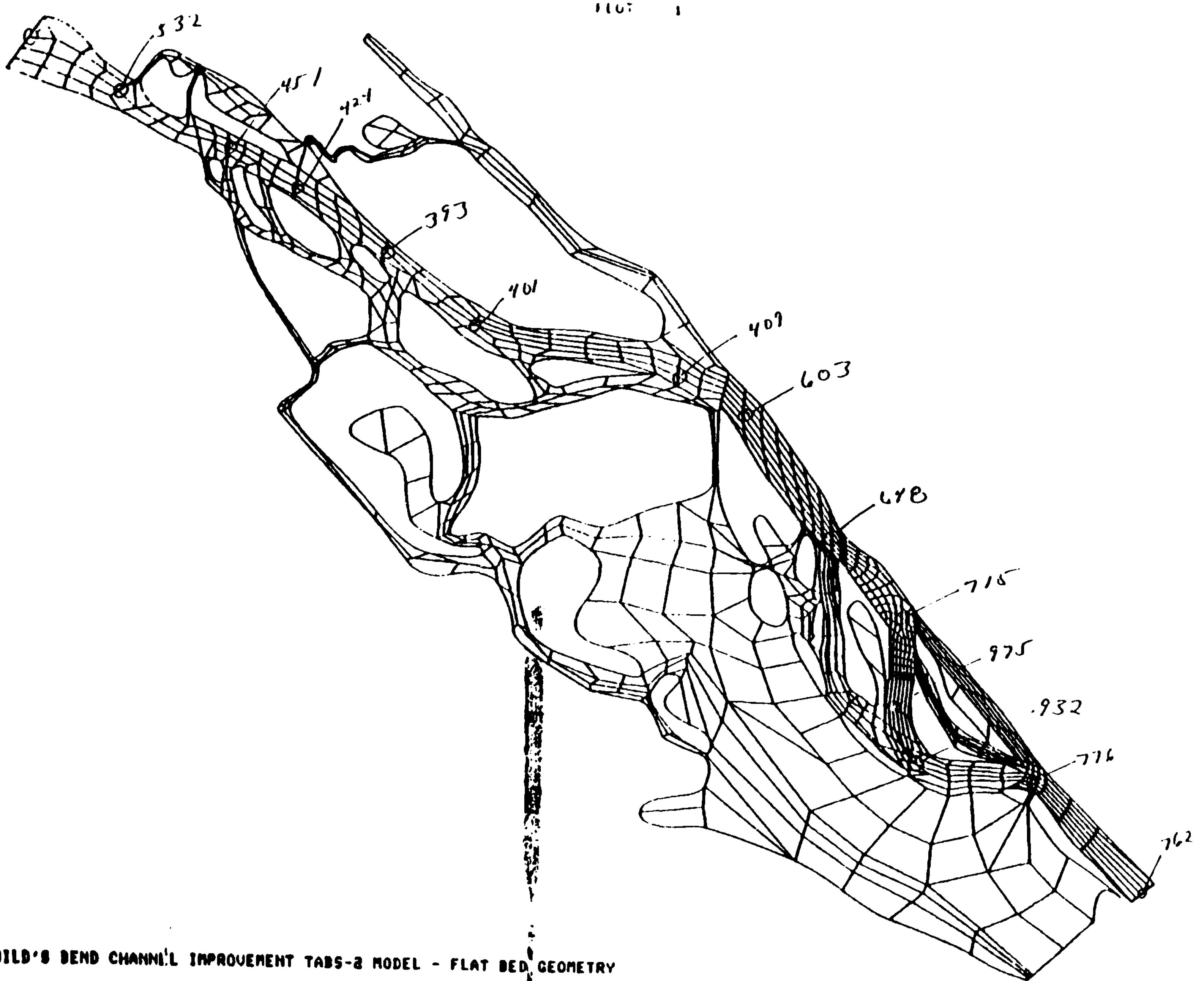
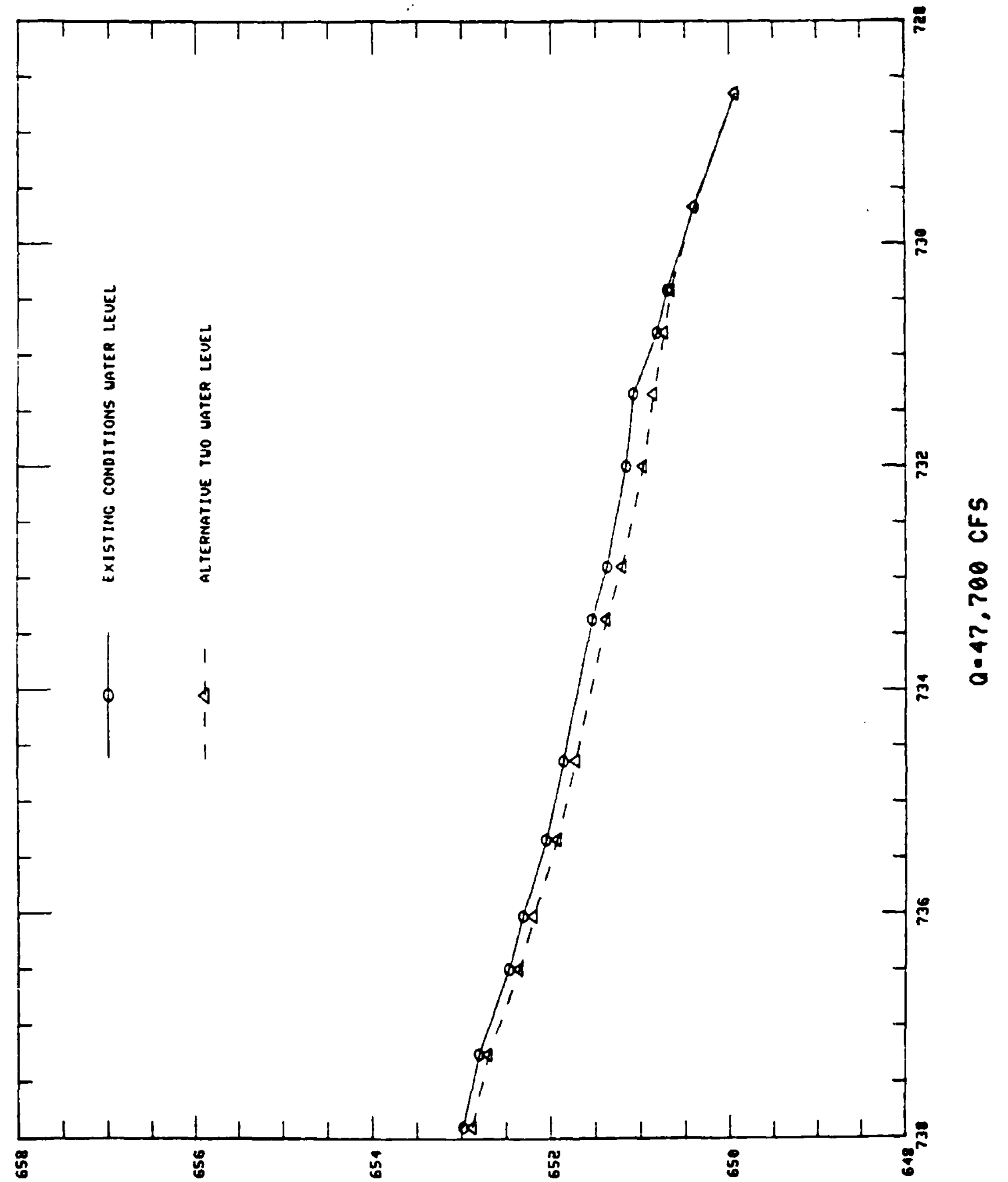
732
PAP SLOUGH
ISLAND 83
SLOUGH
ALTERNATIVE 3
RESTORE PAP'S
SLOUGH
731+
BETSY
ALTERNATIVE 5
(IOWA VANES)
ALTERNATIVE 2A
CUT OFF
ALTERNATIVE 2
730+
CUT OFF
CORPS LAND
FWS LAND
POLANDER
LAKE
+729
McNALLY
LANDING
LOCK & DAM
5A
0
1000
2000
3000
4000
5000 FEET
1 MILE
Wilds Bend - Pool 5A
ALTERNATIVE PLANS

Plate C-3



UILD'S BEND CHANNEL IMPROVEMENT TABS-2 MODEL - FLAT BED GEOMETRY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ALTERNATIVE TWO WATER LEVEL
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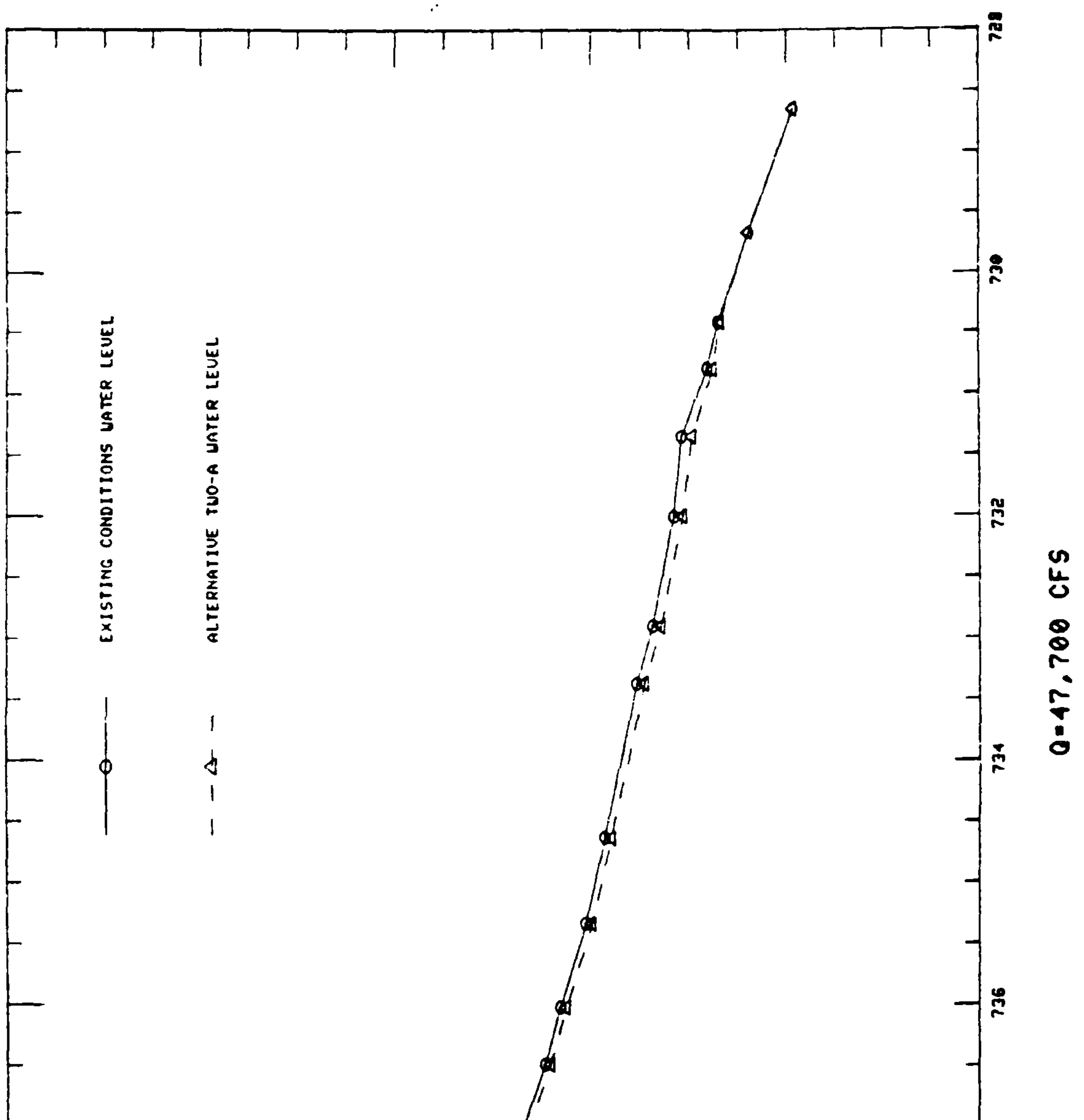
658
656
654
652
650
648
728
730
732
734
736
738

Plate C-5


EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE TWO-A WATER LEVEL
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656
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652
650
648
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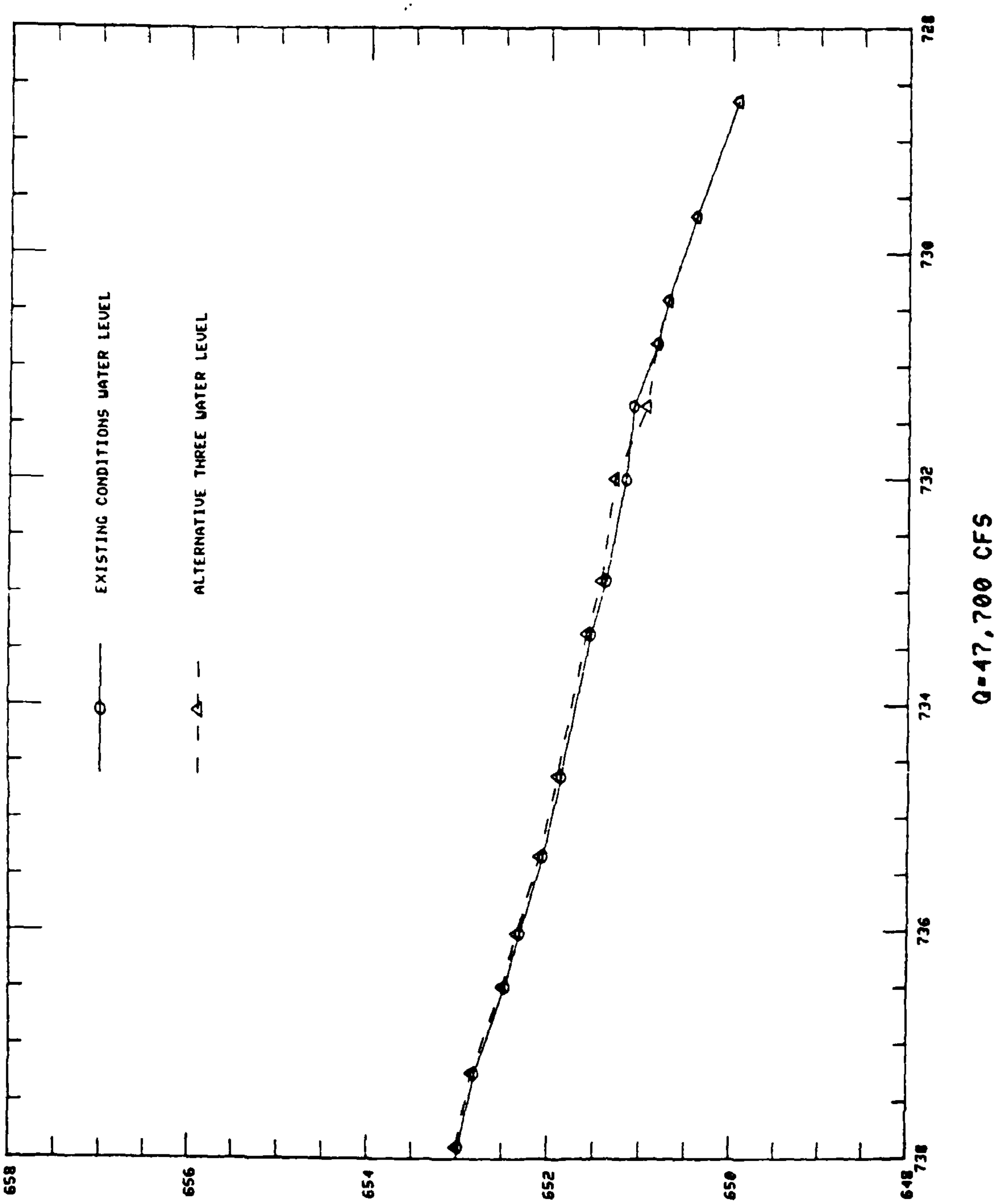
732
730
728

Plate C-6


EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE THREE WATER LEVEL
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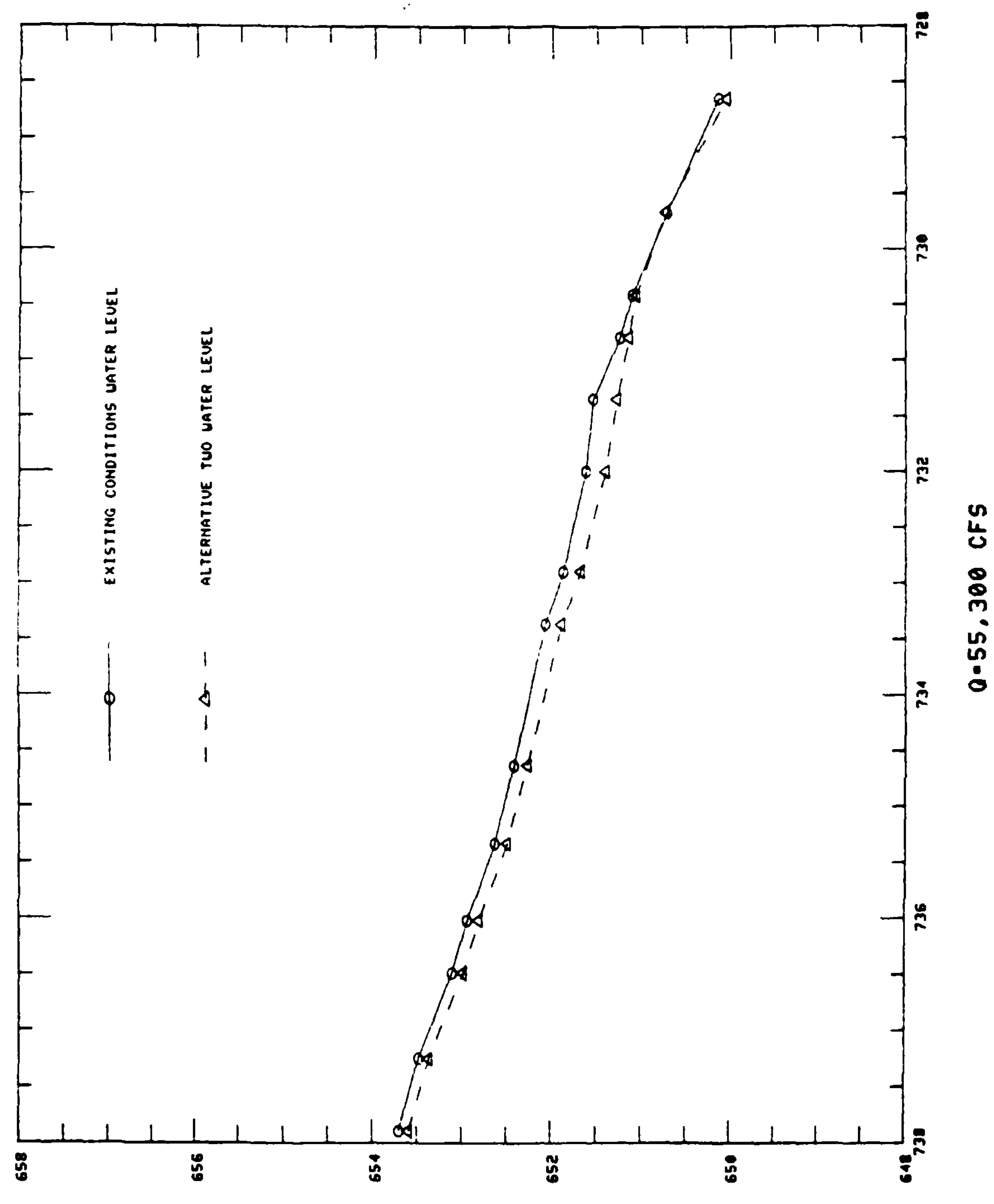
656
654
652
650
648
728
730
732
734
736
738

Plate C-7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ALTERNATIVE TWO WATER LEVEL
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734
732
730
728

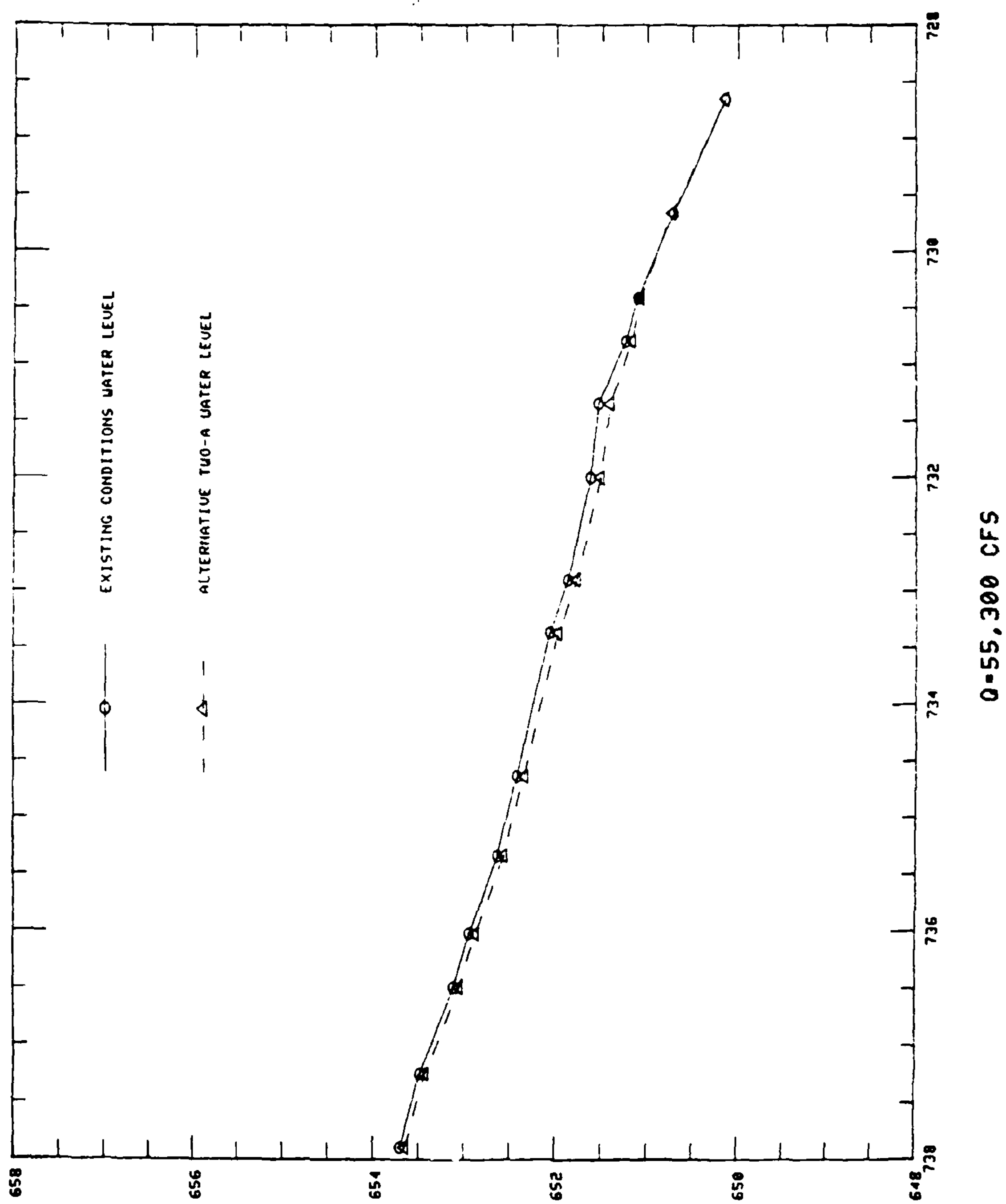
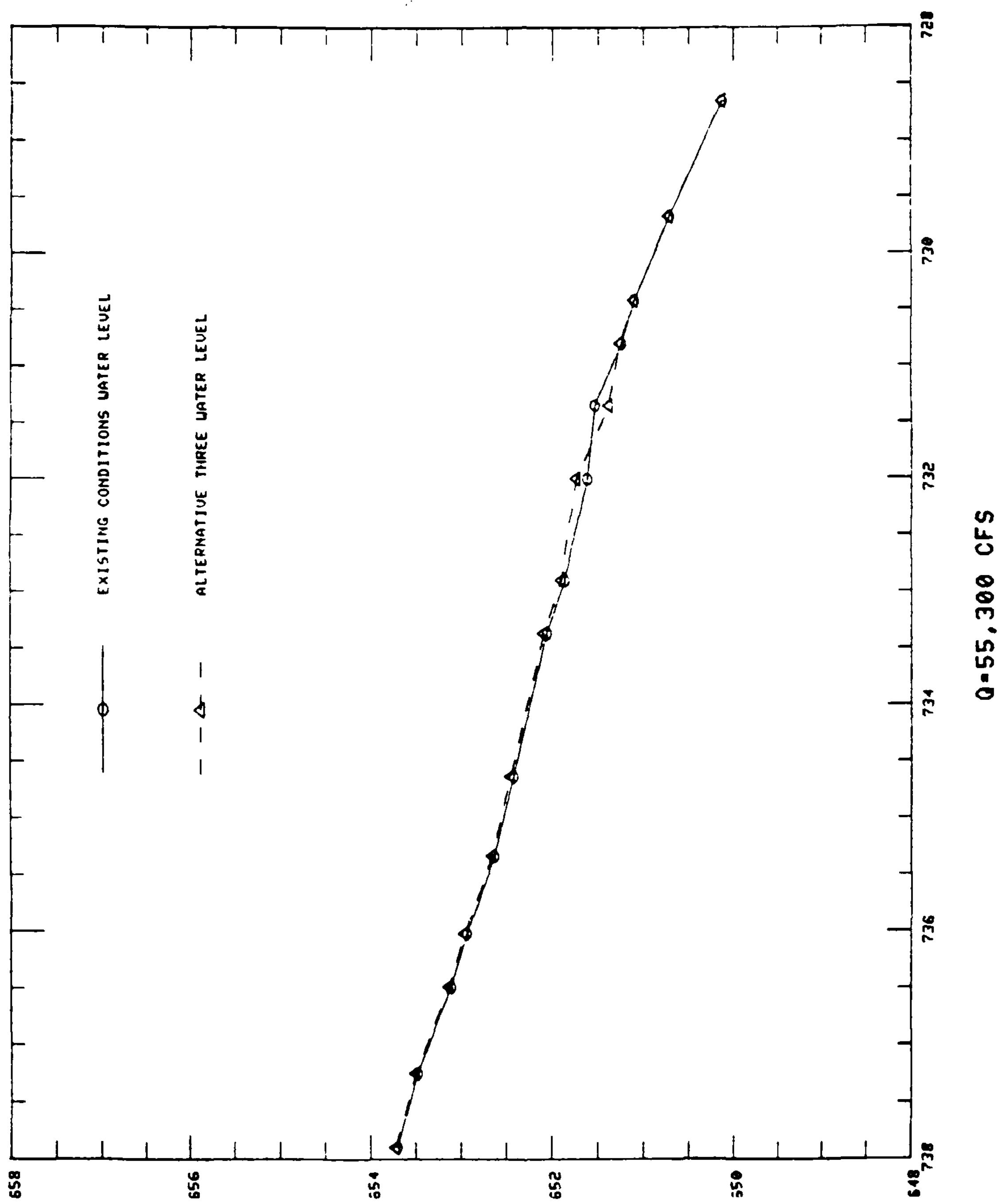

EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE TWO-A WATER LEVEL
Q=55,300 CFS
658
656
654
652
650
648
728
730
732
734
736
738

Plate C-9


EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE THREE WATER LEVEL
Q=55,300 CFS
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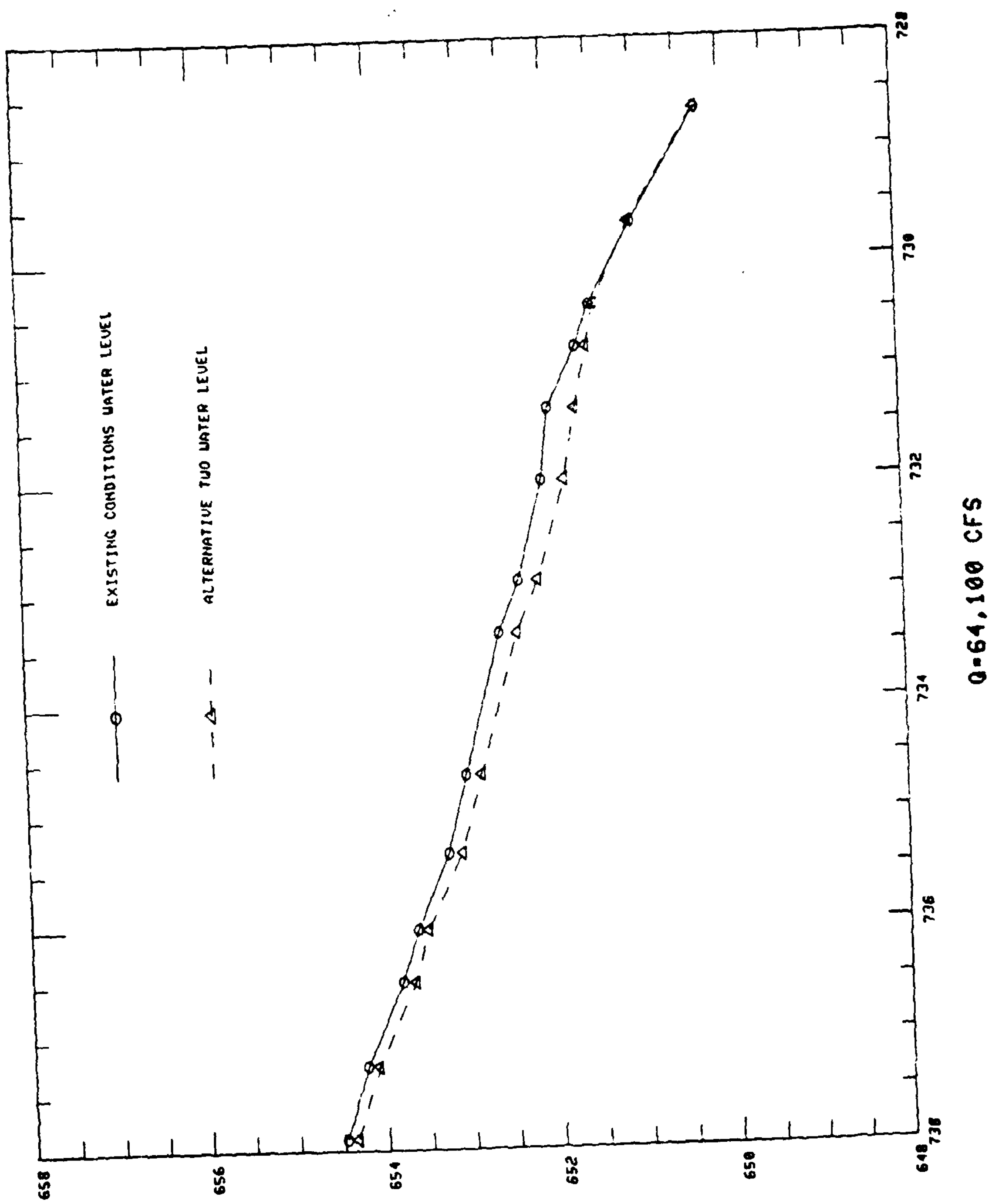
656
654
652
650
648
738
736
734
732
730
728

Plate C-10


EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE TWO WATER LEVEL
Q=64,100 CFS
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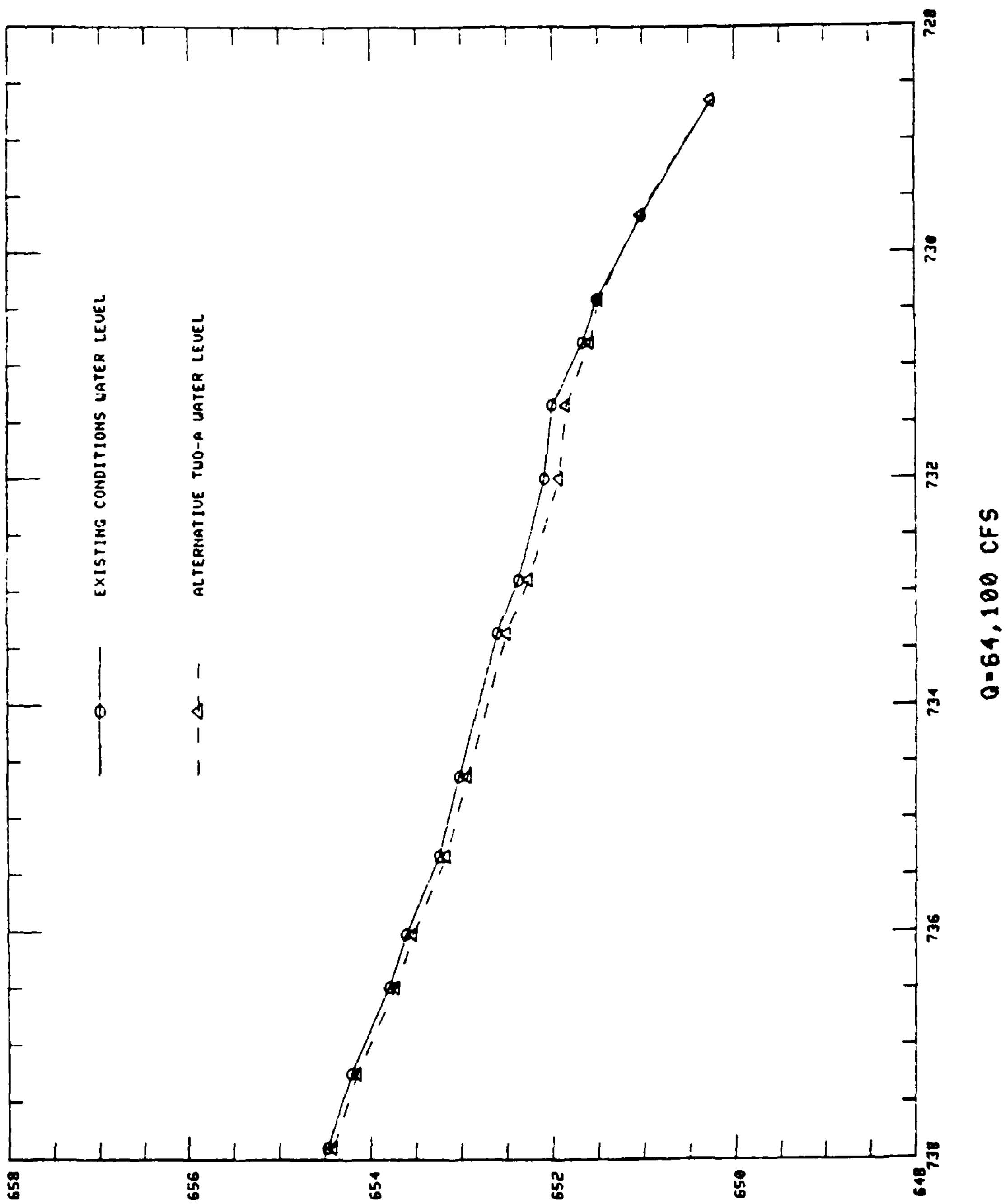
656
654
652
650
648
728
730
732
734
736
738

Plate C-11


EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE TWO-A WATER LEVEL
Q=64,100 CFS
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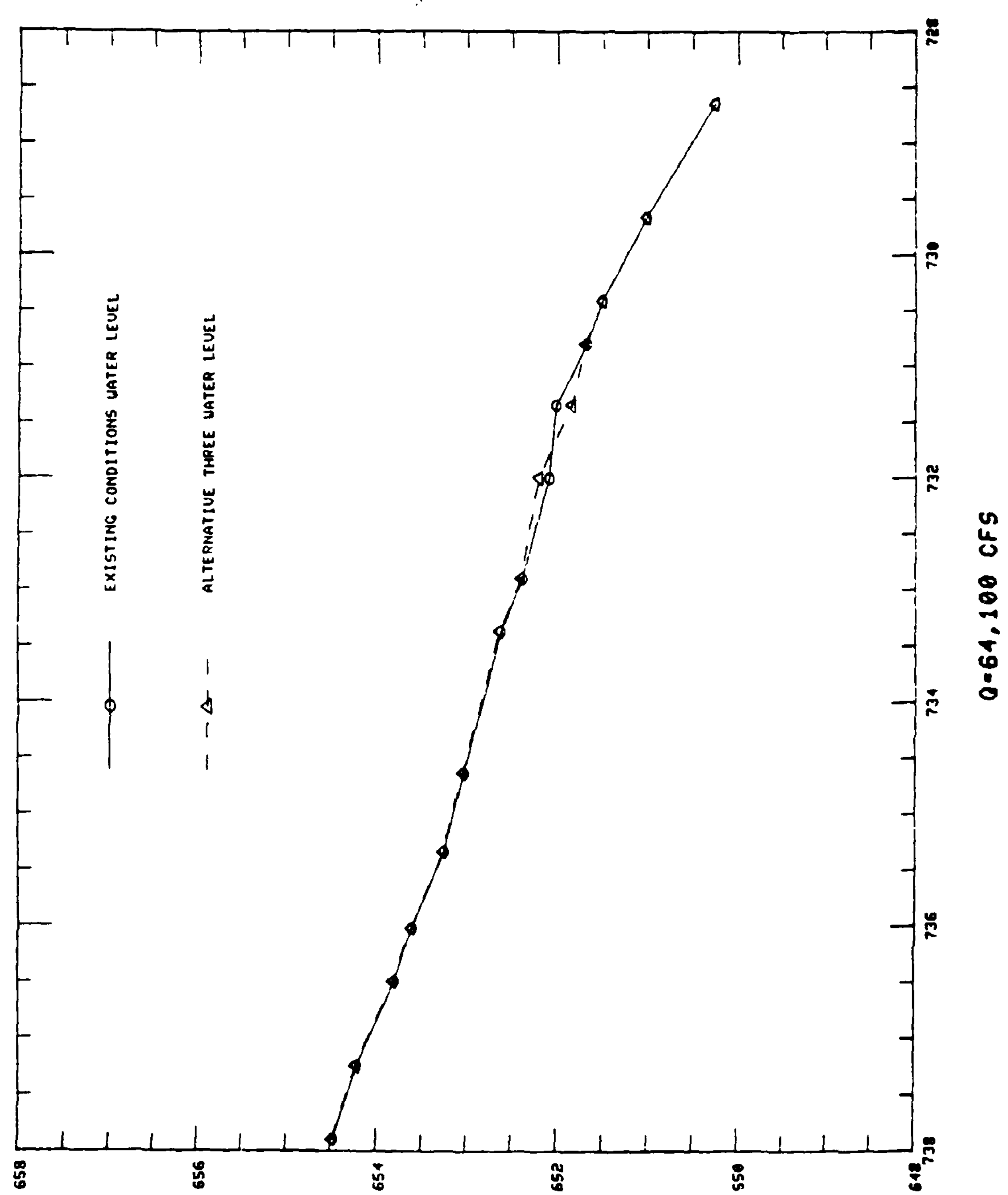
656
654
652
650
648
738
736
734
732
730
728

Plate C-12



EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE THREE WATER LEVEL
Q-64,100 CFS
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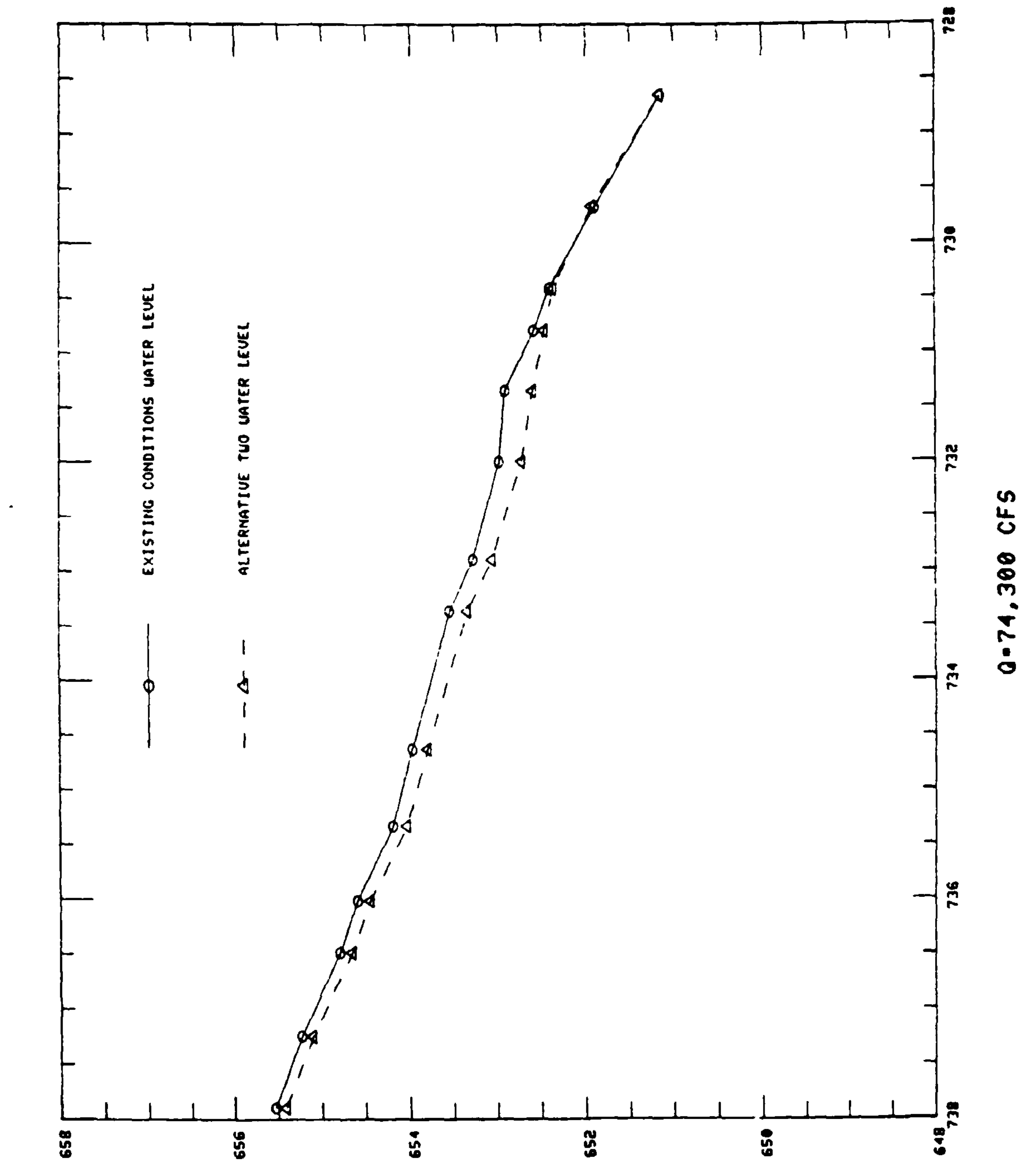
656
654
652
550
648
738
736
734
732
730
728

Plate C-13


EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE TWO WATER LEVEL
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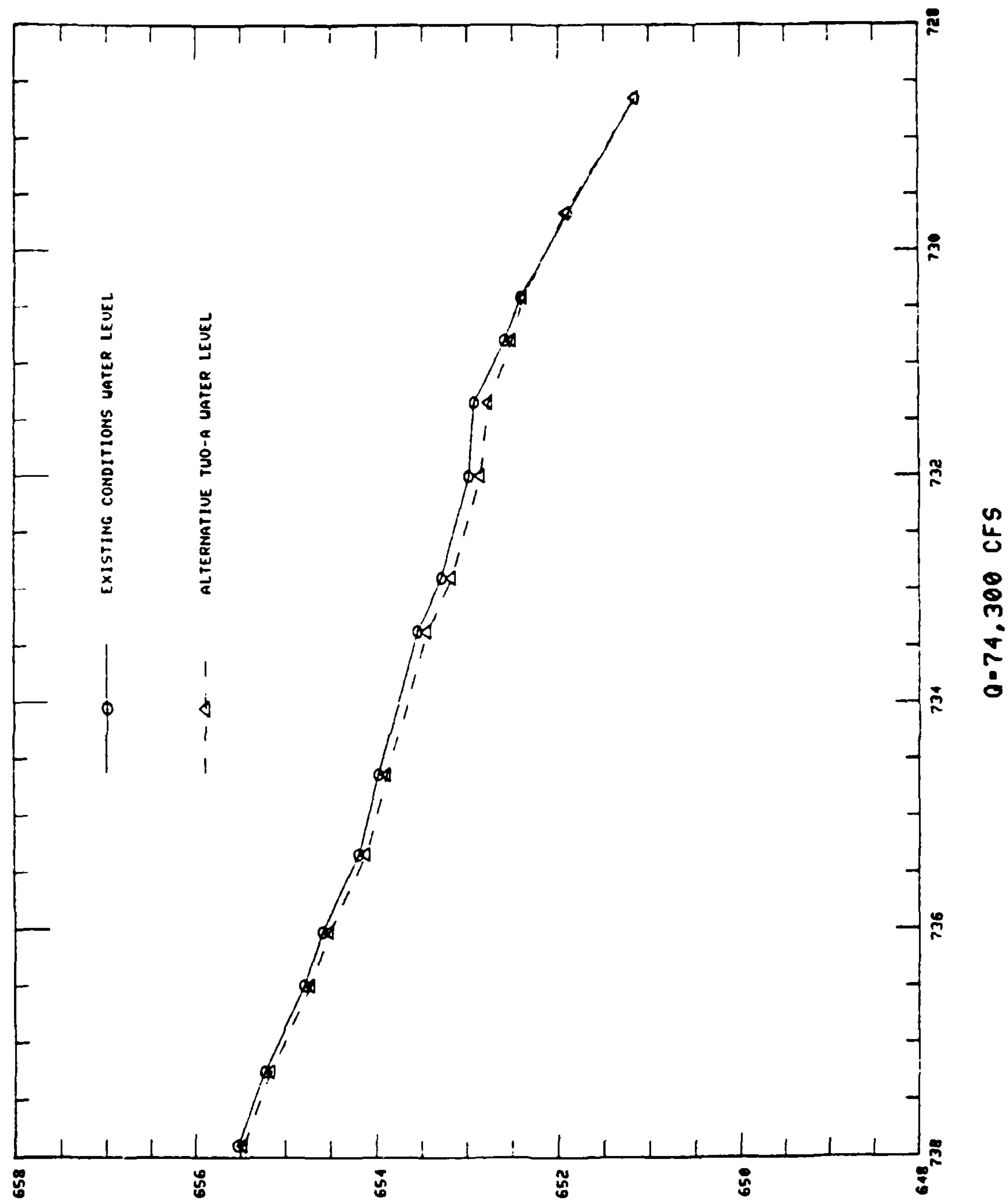
656
654
652
650
648
738
736
734
732
730
728
Q=74,300 CFS

Plate C-14


EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE TWO-A WATER LEVEL
Q=74,300 CFS
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656
654
652
650
648
738
736
734
732
730
728

Plate C-15

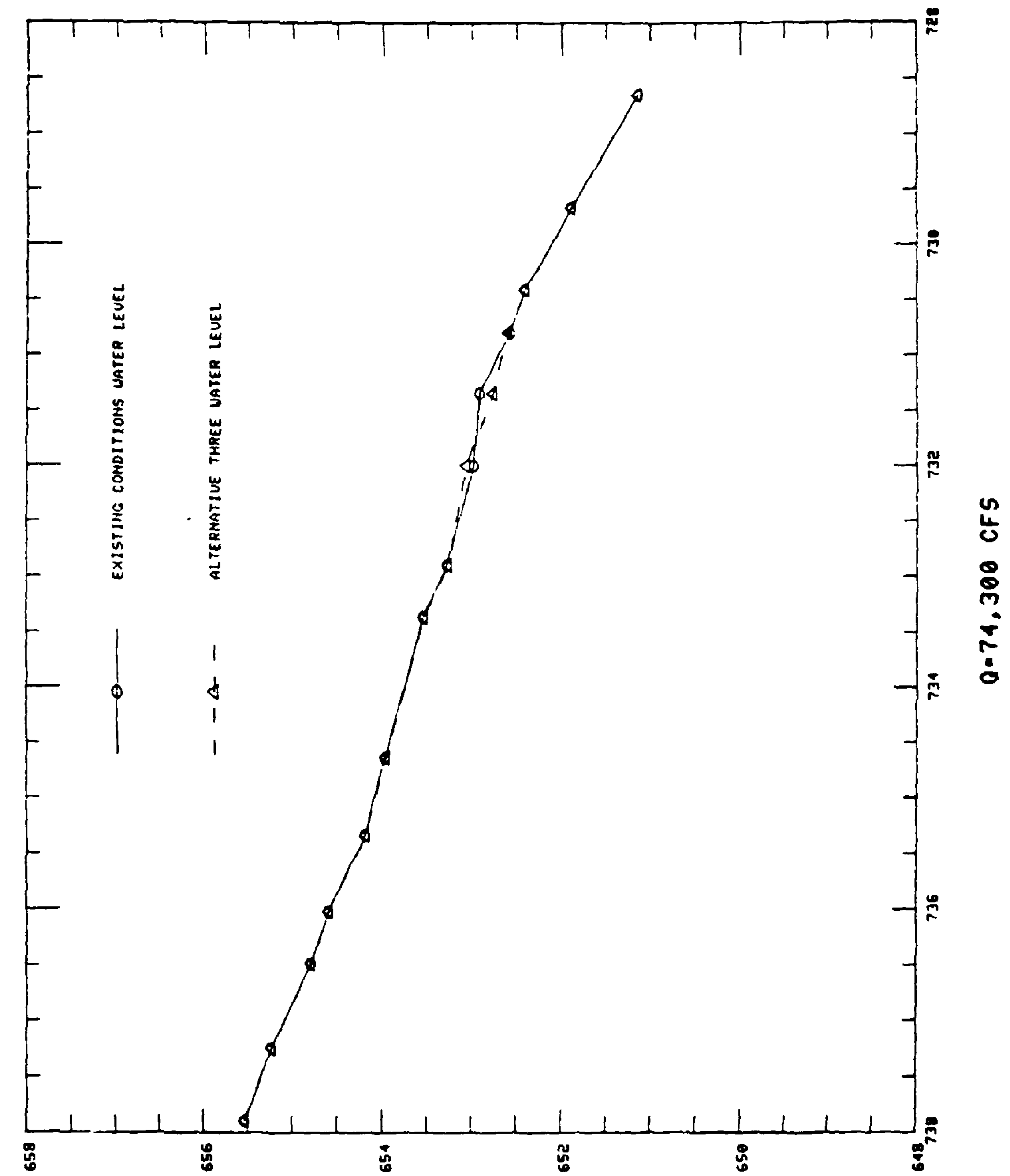

EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE THREE WATER LEVEL
Q=74,300 CFS
658
656
654
652
650
648
738
736
734
732
730
728

Plate C-16

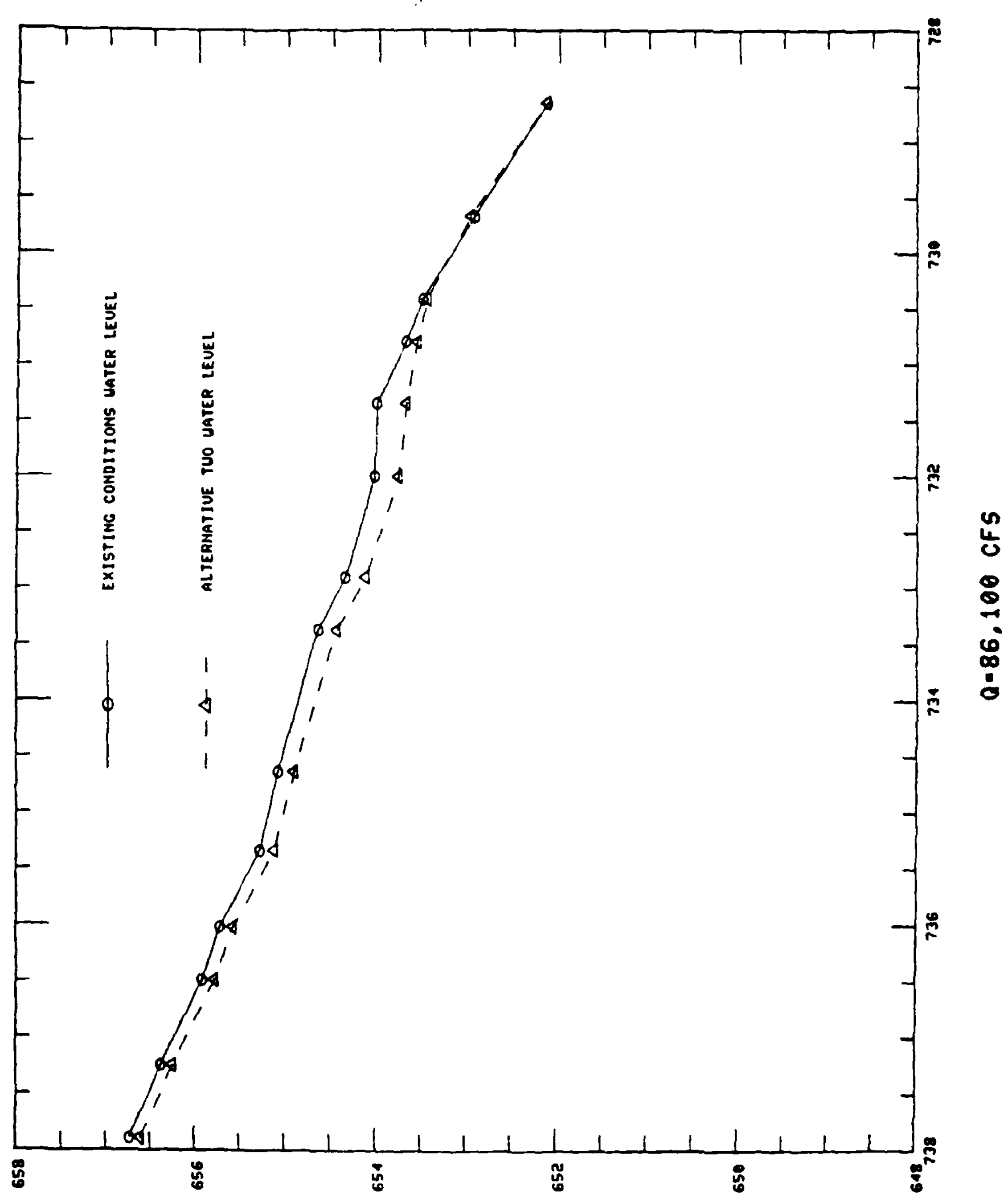
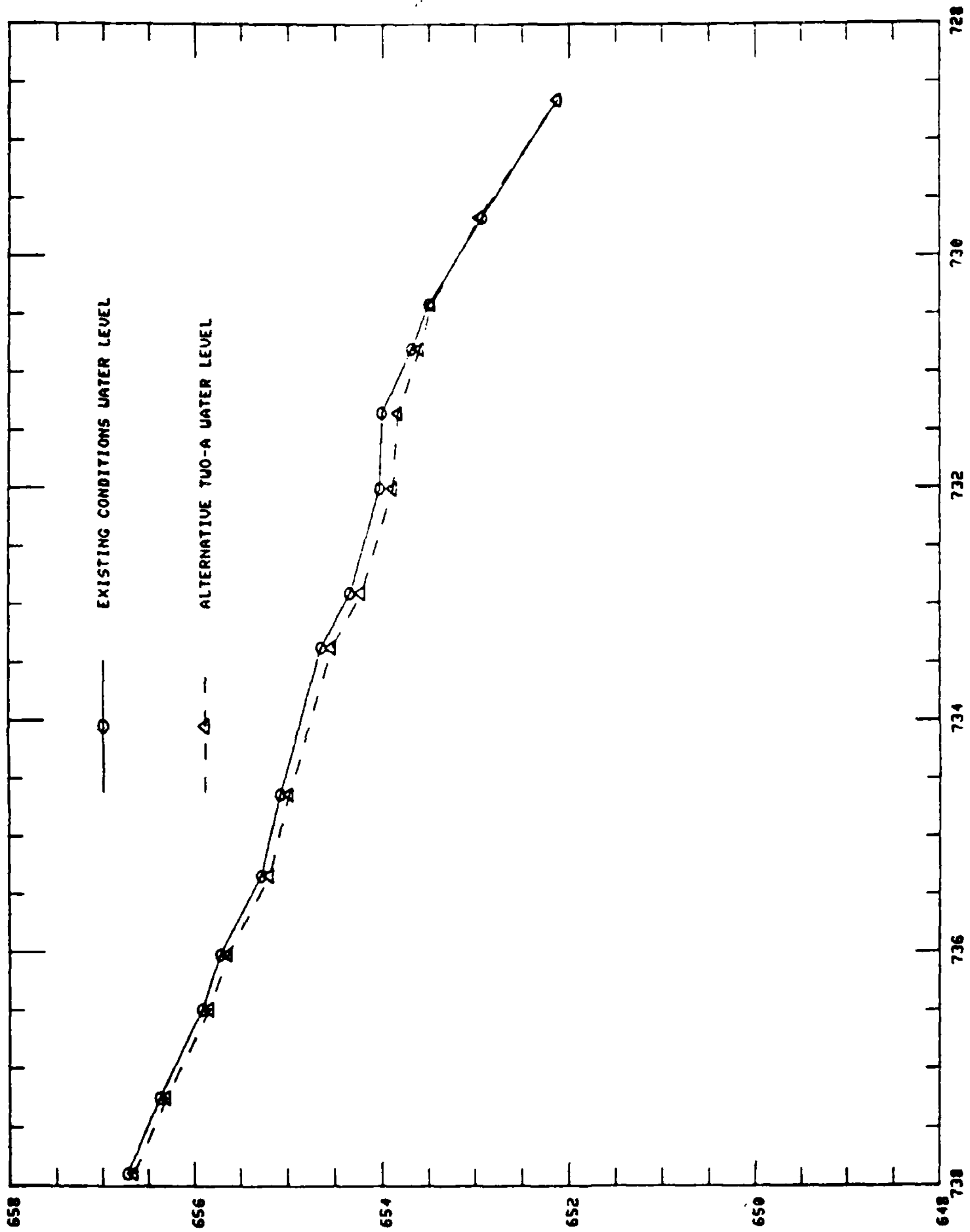
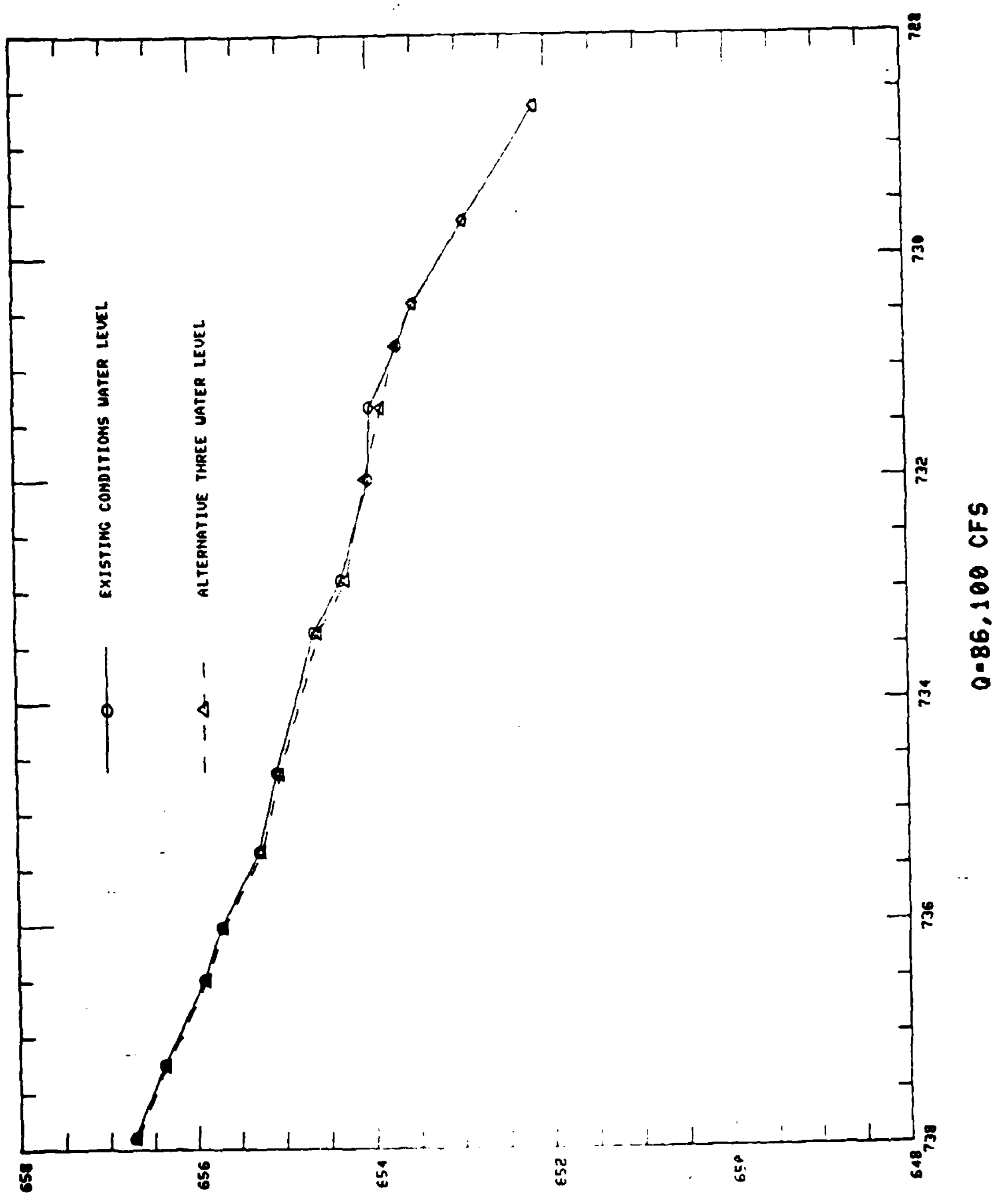

EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE TWO WATER LEVEL
658
656
654
652
650
648
728
730
732
734
736
738
Q=86,100 CFS

Plate C-17



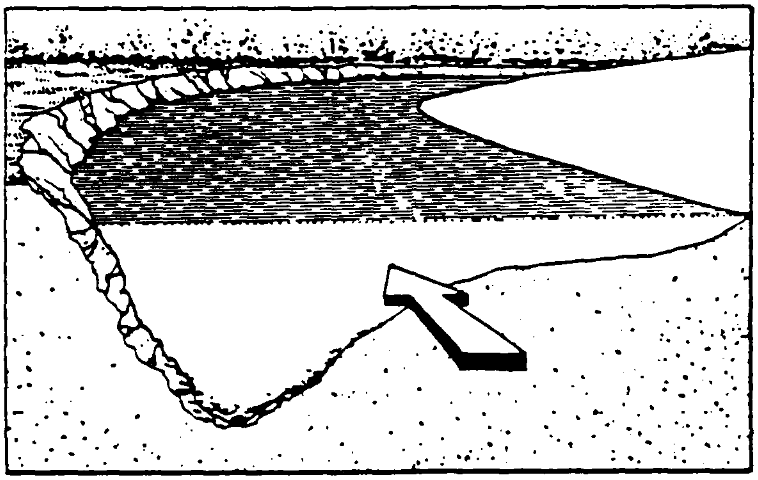
Q=86,100 CFS

Plate C-18

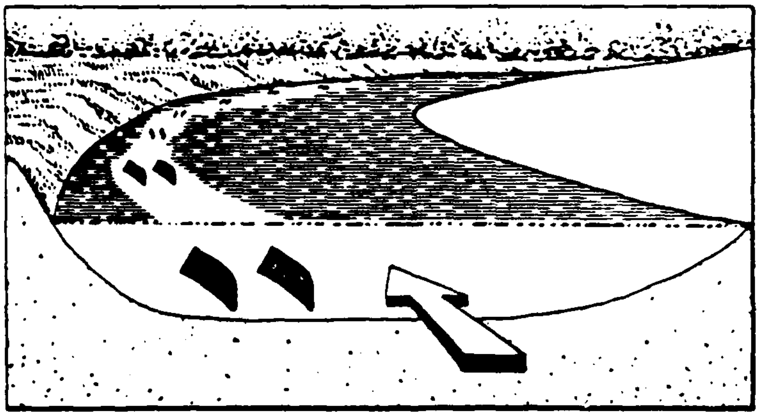


EXISTING CONDITIONS WATER LEVEL
ALTERNATIVE THREE WATER LEVEL
Q=86,100 CFS
658
656
654
652
648
738
736
734
732
730

Plate C-19



ERODING RIVER BEND



RIVER BEND STABILIZED WITH IOWA VANES

Q=47.750 cfs		Existing Conditions			Alternative Two			Alternative Two-A			Alternative Three		
node	distance	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope
552		652.981			652.879	-0.102		652.930	-0.051		653.012	0.031	
	3435.87		0.179	5.21e-05		0.183	5.33e-05		0.181	5.27e-05		0.178	5.18e-05
532		652.802			652.696	-0.106		652.749	-0.053		652.834	0.032	
	3999.91		0.335	8.38e-05		0.343	8.58e-05		0.339	8.48e-05		0.333	8.33e-05
451		652.467			652.353	-0.114		652.410	-0.057		652.501	0.034	
	2490.10		0.155	6.22e-05		0.159	6.39e-05		0.157	6.30e-05		0.153	6.14e-05
424		652.312			652.194	-0.118		652.253	-0.059		652.348	0.036	
	3583.16		0.260	7.26e-05		0.267	7.45e-05		0.264	7.37e-05		0.258	7.20e-05
393		652.052			651.927	-0.125		651.989	-0.063		652.090	0.038	
	3706.14		0.195	5.26e-05		0.208	5.61e-05		0.201	5.42e-05		0.191	5.15e-05
401		651.857			651.719	-0.138		651.788	-0.069		651.899	0.042	
	6696.36		0.321	4.79e-05		0.341	5.09e-05		0.330	4.93e-05		0.316	4.72e-05
409		651.536			651.378	-0.158		651.458	-0.078		651.583	0.047	
	2476.24		0.161	6.50e-05		0.172	6.95e-05		0.166	6.70e-05		0.158	6.38e-05
603		651.375			651.206	-0.169		651.292	-0.083		651.425	0.050	
	4766.68		0.212	4.45e-05		0.233	4.89e-05		0.221	4.64e-05		0.140	2.94e-05
648		651.163			650.973	-0.190		651.071	-0.092		651.285	0.122	
	3419.82		0.080	2.34e-05		0.114	3.33e-05		0.096	2.81e-05		0.348	1.02e-04
715		651.083			650.859	-0.224		650.975	-0.108		650.937	-0.146	
	2927.21		0.260	8.88e-05		0.121	4.13e-05		0.212	7.24e-05		0.103	3.52e-05
975		650.823			650.738	-0.085		650.763	-0.060		650.834	0.011	
	2014.93		0.113	5.61e-05		0.068	3.37e-05		0.078	3.87e-05		0.123	6.10e-05
932		650.710			650.670	-0.040		650.685	-0.025		650.711	0.001	
	3949.95		0.315	7.97e-05		0.262	6.63e-05		0.281	7.11e-05		0.316	8.00e-05
776		650.395			650.408	0.013		650.404	0.009		650.395	0.000	
	4926.190		0.465	9.44e-05		0.474	9.62e-05		0.472	9.58e-05		0.466	9.46e-05
762		649.930			649.934	0.004		649.932	0.002		649.929	-0.001	

TABLE 1

Note: For the Alternatives, the value listed in the dwsel column on the same line as the wsel is the difference between that wsel and the Existing Conditions wsel at the same node. The value listed on the line between wsel's is the difference between the wsel's at those two nodes for that alternative.

Q=55,300 cfs		Existing Conditions			Alternative Two			Alternative Two-A			Alternative Three		
node	distance	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope
552		653.702			653.590	-0.112		653.645	-0.057		653.724	0.022	
	3435.87		0.217	6.32e-05		0.220	6.40e-05		0.219	6.37e-05		0.216	6.29e-05
532		653.485			653.370	-0.115		653.426	-0.059		653.508	0.023	
	3999.91		0.375	9.38e-05		0.386	9.65e-05		0.380	9.50e-05		0.374	9.35e-05
451		653.110			652.984	-0.126		653.046	-0.064		653.134	0.024	
	2499.10		0.171	6.87e-05		0.176	7.07e-05		0.174	6.99e-05		0.170	6.83e-05
424		652.939			652.808	-0.131		652.872	-0.067		652.964	0.025	
	3583.16		0.305	8.51e-05		0.313	8.74e-05		0.309	8.62e-05		0.303	8.46e-05
393		652.634			652.495	-0.139		652.563	-0.071		652.661	0.027	
	3706.14		0.211	5.69e-05		0.226	6.10e-05		0.218	5.88e-05		0.208	5.61e-05
401		652.423			652.269	-0.154		652.345	-0.078		652.453	0.030	
	6696.36		0.363	5.42e-05		0.388	5.79e-05		0.375	5.60e-05		0.360	5.38e-05
409		652.060			651.881	-0.179		651.970	-0.090		652.093	0.033	
	2476.24		0.195	7.87e-05		0.207	8.36e-05		0.201	8.12e-05		0.192	7.75e-05
603		651.865			651.674	-0.191		651.769	-0.096		651.901	0.036	
	4766.68		0.244	5.12e-05		0.271	5.69e-05		0.256	5.37e-05		0.162	3.40e-05
548		651.621			651.403	-0.218		651.513	-0.108		651.739	0.118	
	3419.82		0.082	2.40e-05		0.125	3.66e-05		0.101	2.95e-05		0.354	1.04e-04
715		651.539			651.278	-0.261		651.412	-0.127		651.385	-0.154	
	2927.21		0.293	1.00e-04		0.132	4.51e-05		0.236	8.06e-05		0.122	4.17e-05
975		651.246			651.146	-0.100		651.176	-0.070		651.263	0.017	
	2014.93		0.134	6.65e-05		0.079	3.92e-05		0.092	4.57e-05		0.149	7.39e-05
932		651.112			651.067	-0.045		651.084	-0.028		651.114	0.002	
	3949.95		0.393	9.95e-05		0.329	8.33e-05		0.352	8.91e-05		0.393	9.95e-05
776		650.719			650.738	0.019		650.732	0.013		650.721	0.002	
	4926.190		0.587	1.19e-04		0.700	1.42e-04		0.597	1.21e-04		0.588	1.19e-04
[illegible]		650.132			650.038	-0.094		650.135	0.003		650.133	0.001	

TABLE 2

Q=64.100 cfs		Existing Conditions			Alternative Two			Alternative Two-A			Alternative Three		
node	distance	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope
552		654.473			654.351	-0.122		654.409	-0.064		654.485	0.012	
	3435.87		0.261	7.60e-05		0.266	7.74e-05		0.263	7.65e-05		0.260	7.57e-05
532		654.212			654.085	-0.127		654.146	-0.066		654.225	0.013	
	3999.91		0.420	1.05e-04		0.432	1.08e-04		0.426	1.07e-04		0.419	1.05e-04
451		653.792			653.653	-0.139		653.720	-0.072		653.806	0.014	
	2490.10		0.189	7.59e-05		0.164	6.59e-05		0.192	7.71e-05		0.188	7.55e-05
424		653.603			653.489	-0.114		653.528	-0.075		653.618	0.015	
	3583.16		0.358	9.99e-05		0.400	1.12e-04		0.364	1.02e-04		0.358	9.99e-05
393		653.245			653.089	-0.156		653.164	-0.081		653.260	0.015	
	2706.14		0.227	6.12e-05		0.245	6.61e-05		0.236	6.37e-05		0.225	6.07e-05
301		653.018			652.844	-0.174		652.928	-0.090		653.035	0.017	
	6696.36		0.412	6.15e-05		0.441	6.59e-05		0.425	6.35e-05		0.409	6.11e-05
109		652.606			652.403	-0.203		652.503	-0.103		652.626	0.020	
	2476.24		0.235	9.49e-05		0.251	1.01e-04		0.243	9.81e-05		0.234	9.45e-05
603		652.371			652.152	-0.219		652.260	-0.111		652.392	0.021	
	4766.68		0.282	5.92e-05		0.316	6.63e-05		0.334	7.01e-05		0.188	3.94e-05
648		652.089			651.836	-0.253		651.926	-0.163		652.204	0.115	
	3419.82		0.083	2.43e-05		0.136	3.98e-05		0.072	2.11e-05		0.366	1.07e-04
715		652.006			651.700	-0.306		651.854	-0.152		651.838	-0.168	
	2927.21		0.332	1.13e-04		0.144	4.92e-05		0.262	8.95e-05		0.144	4.92e-05
975		651.674			651.556	-0.118		651.592	-0.082		651.694	0.020	
	2014.93		0.160	7.94e-05		0.095	4.71e-05		0.110	5.46e-05		0.180	8.93e-05
932		651.514			651.461	-0.053		651.482	-0.032		651.514	0.000	
	3949.95		0.497	1.26e-04		0.417	1.06e-04		0.447	1.13e-04		0.497	1.26e-04
776		651.017			651.044	0.027		651.035	0.018		651.017	0.000	
	4926.190		0.757	1.54e-04		0.775	1.57e-04		0.770	1.56e-04		0.757	1.54e-04
762		650.260			650.269	0.009		650.265	0.005		650.260	0.000	

TABLE 3

Q=74,300 cfs		Existing Conditions			Alternative Two			Alternative Two-A			Alternative Three		
node	distance	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope
552		655.533			655.412	-0.121		655.468	-0.065		655.528	-0.005	
	3435.87		0.304	8.85e-05		0.309	8.99e-05		0.306	8.91e-05		0.304	8.85e-05
532		655.229			655.103	-0.126		655.162	-0.067		655.224	-0.005	
	3999.91		0.444	1.11e-04		0.457	1.14e-04		0.451	1.13e-04		0.445	1.11e-04
451		654.785			654.646	-0.139		654.711	-0.074		654.779	-0.006	
	2490.10		0.197	7.91e-05		0.202	8.11e-05		0.200	8.03e-05		0.197	7.91e-05
424		654.588			654.444	-0.144		654.511	-0.077		654.582	-0.006	
	3583.16		0.401	1.12e-04		0.413	1.15e-04		0.407	1.14e-04		0.402	1.12e-04
393		654.187			654.031	-0.156		654.104	-0.083		654.180	-0.007	
	3706.14		0.217	5.86e-05		0.234	6.31e-05		0.226	6.10e-05		0.219	5.91e-05
401		653.970			653.797	-0.173		653.878	-0.092		653.961	-0.009	
	6696.36		0.427	6.38e-05		0.455	6.79e-05		0.441	6.59e-05		0.429	6.41e-05
409		653.543			653.342	-0.201		653.437	-0.106		653.532	-0.011	
	2476.24		0.266	1.07e-04		0.285	1.15e-04		0.275	1.11e-04		0.269	1.09e-04
603		653.277			653.057	-0.220		653.162	-0.115		653.263	-0.014	
	4766.68		0.299	6.27e-05		0.336	7.05e-05		0.316	6.63e-05		0.201	4.22e-05
648		652.978			652.721	-0.257		652.846	-0.132		653.062	0.084	
	3419.82		0.066	1.93e-05		0.122	3.57e-05		0.093	2.72e-05		0.301	8.80e-05
715		652.912			652.599	-0.313		652.753	-0.159		652.761	-0.151	
	2927.21		0.334	1.14e-04		0.138	4.71e-05		0.257	8.78e-05		0.157	5.36e-05
975		652.578			652.461	-0.117		652.496	-0.082		652.604	0.026	
	2014.93		0.170	8.44e-05		0.100	4.96e-05		0.117	5.81e-05		0.198	9.83e-05
932		652.408			652.361	-0.047		652.379	-0.029		652.406	-0.002	
	3949.95		0.511	1.29e-04		0.429	1.09e-04		0.459	1.16e-04		0.509	1.29e-04
776		651.897			651.932	0.035		651.920	0.023		651.897	0.000	
	4926.190		0.749	1.52e-04		0.775	1.57e-04		0.767	1.56e-04		0.749	1.52e-04
762		651.148			651.157	0.009		651.153	0.005		651.148	0.000	

TABLE 4

Q=86,100 cfs		Existing Conditions			Alternative Two			Alternative Two-A			Alternative Three		
node	distance	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope	wsel	dwsel	slope
552		656.731			656.608	-0.123		656.661	-0.070		656.703	-0.028	
	3435.87		0.351	1.02e-04		0.357	1.04e-04		0.354	1.03e-04		0.352	1.02e-04
532		656.380			656.251	-0.129		656.307	-0.073		656.351	-0.029	
	3999.91		0.464	1.16e-04		0.476	1.19e-04		0.470	1.18e-04		0.467	1.17e-04
451		655.916			655.775	-0.141		655.837	-0.079		655.884	-0.032	
	2490.10		0.200	8.03e-05		0.206	8.27e-05		0.204	8.19e-05		0.202	8.11e-05
424		655.716			655.569	-0.147		655.633	-0.083		655.682	-0.034	
	3583.16		0.446	1.24e-04		0.457	1.28e-04		0.452	1.26e-04		0.448	1.25e-04
393		655.270			655.112	-0.158		655.181	-0.089		655.234	-0.036	
	3706.14		0.200	5.40e-05		0.216	5.83e-05		0.208	5.61e-05		0.206	5.56e-05
401		655.070			654.896	-0.174		654.973	-0.097		655.028	-0.042	
	6696.36		0.433	6.47e-05		0.461	6.88e-05		0.448	6.69e-05		0.443	6.62e-05
409		654.637			654.435	-0.202		654.525	-0.112		654.585	-0.052	
	2476.24		0.301	1.22e-04		0.320	1.29e-04		0.311	1.26e-04		0.309	1.25e-04
603		654.336			654.115	-0.221		654.214	-0.122		654.276	-0.060	
	4766.68		0.313	6.57e-05		0.352	7.38e-05		0.332	6.97e-05		0.216	4.53e-05
648		654.023			653.763	-0.260		653.882	-0.141		654.060	0.037	
	3419.82		0.027	7.90e-06		0.088	2.57e-05		0.058	1.70e-05		0.197	5.76e-05
715		653.996			653.675	-0.321		653.824	-0.172		653.863	-0.133	
	2927.21		0.316	1.08e-04		0.119	4.07e-05		0.233	7.96e-05		0.157	5.36e-05
975		653.680			653.556	-0.124		653.591	-0.089		653.706	0.026	
	2014.93		0.185	9.18e-05		0.109	5.41e-05		0.127	6.30e-05		0.212	1.05e-04
932		653.495			653.447	-0.048		653.464	-0.031		653.494	-0.001	
	3949.95		0.572	1.45e-04		0.480	1.22e-04		0.511	1.29e-04		0.571	1.45e-04
776		652.923			652.967	0.044		652.953	0.030		652.923	0.000	
	4926.190		0.798	1.62e-04		0.832	1.69e-04		0.821	1.67e-04		0.798	1.62e-04
762		652 125			652.135	0.010		652.132	0.007		652.125	0.000	

TABLE 5

APPENDIX D

RECREATION RESOURCES

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TABLES

DESCRIPTION OF POOL 5A

PHYSICAL CHARACTERISTICS

Lock and dam 5A is 3 river miles above Winona, Minnesota, at mile 728.5. It has the lowest lift (5.5 feet) of the 13 navigation locks and dams in the St. Paul District. Of the pools below locks and dam 1, pool 5A is the shortest, and it has the smallest water area and least shoreline accessible by land. There are no tributary rivers in pool 5A.

In other respects, this pool has the typical features of a wide floodplain extending across the valley between high bluffs, with the main channel meandering through the alluvial fill and the multilevel terraces and lowlands formed by glacial outwash. The main channel upstream of lock and dam 5A follows the Wisconsin side up to Fountain City (mile 733). At this point, the channel cuts diagonally across the floodplain to Minnesota and lock and dam 5 (mile 738.1).

Principal Features of Pool 5A

Length of pool	9.6 river miles
River mile limits	728.5 - 738.1
Average pool elevation	651.0 feet msl
Pool surface area	6,140 acres
Shoreline miles (meandering outer perimeter)	35 miles
Corps-owned land	3,915 acres: 570 acres above normal flat pool 3,870 acres managed by FWS

VISUAL ASSESSMENT

Pool 5A is characterized as an urban/natural landscape zone. Although its topography is a complex of islands and river with an extensive "meandering outer perimeter" of 35 miles, visitors obtain access more frequently (26 percent) near Winona, Minnesota, than from any other area on the pool.

The city of Winona is in the river floodplain. Its distance from bordering bluffs gives the visitor a low viewing angle, a low sense of landform containment, and low river awareness.

DOMINANT LANDSCAPE ZONE CHARACTERISTICS

		Zone Location	Mpls. - CBD	Mpls. - Lower Gorge	Fort Snelling	St. Paul - CBD	South St. Paul	Grey Cloud Is.	Spring Lake	Hastings	Prescott	Prairie Island	Red Wing	Lake Pepin	Wabasha	Buffalo City	Winona	Trempealeau	La Crosse	Brownsville	New Albin	Lansing	Harper's Ferry	Prairie du Chien	Guttenberg
		Zone Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
LAND USE	1	Urban/Industrial	●			●	●																		
	2	Urban/Residential		●						●									●						
	3	Urban/Agricultural											●												
	5	Urban/Natural			●												●							●	
	6	Agricultural/Industrial						●																	
	8	Agricultural							●																
	9	Agricultural/Natural										●			●	●		●			●		●		
	10	Natural									●			●						●		●			●
RIVER ZONES	10	Channel	●	●		●	●			●															
	7	Island/River			●			●				●					●		●				●		
	4	Marsh/River									●		●		●			●			●			●	
	1	Open Water							●					●		●				●		●			●
VIEWING ANGLE	1	Above	●	●	●	●			●	●	●	●													
	5	Mid-level					●							●	●	●			●	●	●	●	●	●	●
	10	Low						●					●				●	●							
RIVER AWARENESS	10	High	●	●	●					●				●					●	●		●		●	
	5	Moderate													●	●							●		●
	1	Low				●	●	●	●		●	●	●				●	●			●				
LANDFORM CONTAINMENT	10	High		●	●	●				●										●		●	●	●	●
	5	Moderate	●				●							●				●			●				
	1	Low						●	●		●	●	●		●	●	●		●						
		Total Score	27	33	33	23	22	25	12	33	17	19	13	31	24	21	24	29	25	36	24	36	37	34	31

PROCESS DIAGRAM

FEDERAL LANDS ON POOL 5A

OPERATIONS

Areas of Federal land allocated as project operations include the Corps Fountain City Service Base, the lock and dam 5 facilities, the levee structure along the lower pool area, and the historic dredged material placement site 5A.08 at mile 730.5.

About 30 acres of Corps lands at lock and dam 5A and at the Fountain City Service Base have been retained for exclusive Corps use.

The pool 5A operating plan is a variation of the recommended plan (alternative A1) from the Dredged Material Placement Reconnaissance Report for Pool 5A, May 1983. The plan established dredged material placement sites for use over the next 40 years.

The current operating plan uses four placement sites. Beneficial-use removal sites are site 5A.36 at lock and dam 5 and site 5A.25 below Fountain City, Wisconsin. Permanent placement sites are site 5A.32 (14 acres) at Fountain City and Wild's Bend, site 5A.08 (6 acres). Use of an additional area at site 5A.23 (Bass Camp) for recreation development fill depends upon beneficial-use removal at site 5A.36.

RECREATION/WILD/NATURAL LANDS

The Corps of Engineers has acquired about 3,915 acres of federally-owned land and water area, and it holds special rights on an additional 1,200 acres administered by the Fish and Wildlife Service (FWS). Of the 3,915 acres of Corps-administered land and water, the Fish and Wildlife Service manages about 3,870 acres as part of the Upper Mississippi National Wildlife and Fish Refuge in conjunction with FWS-owned lands.

Corps lands allocated for recreation include the 11-acre Minnesota City Boat Club (intensive-use) area, a 1.3-acre Wisconsin Highway Department wayside park, and an area used as part of the Winona Prairie Island Park, all leased from the Corps.

Two areas adjacent to the lower pool levee at Winona, Minnesota, are allocated as natural areas because of the presence of native prairie species that are important to local educational institutions. The natural area allocation will not adversely affect use of the boat ramps at Upper and Lower McNally Landing.

The remaining Federal lands in pool 5A are allocated as wildlife management and are in the Upper Mississippi National Wildlife and Fish Refuge. The Minnesota City Boat Club lease, the Prairie Island Park tract, the Fountain City Service Base, the lower pool levee, and the lock and dam 5 facilities are the only Federal land areas outside of the refuge.

COMMERCIAL/INDUSTRIAL USE OF POOL 5A

NAVIGATION

No commercial navigation facilities are available in this pool. However, in 1986 there were 2,140 commercial lockages through lock and dam 5A.

UTILITIES

The following utility, transportation, and commercial/industrial activities or easements are on Federal lands in pool 5A:

Northwestern Bell - underground telephone cable easement construction and maintenance

Northern States Power - construction, operation, and maintenance of electric power transmission line

Wisconsin State Highway Commission - construction, use, and maintenance of public highways

Primary highways closely parallel both sides of the river. Primary and secondary highways plus county and township roads provide lateral access, but no highways cross the river in pool 5A.

COMMERCIAL RECREATIONAL

Commercial docking for recreational craft, boat rental, and related services are available at various points in the pool area. Boat and motor sales and service are available in the nearby city of Winona, Minnesota. The nearest commercial airport is also in Winona.

RECREATIONAL USE OF POOL 5A

NATURAL RESOURCES

Fish and wildlife habitat are generally very good in pool 5A. There is substantial commercial fishing. The low level of water pollution in this pool is not harmful to fish and wildlife. Much of the pool lies within the Winona District of the Upper Mississippi National Wildlife and Fish Refuge.

The Fountain City Bay area and the extensive backwater between Fountain City, Wisconsin, and Minnesota City, Minnesota, provide excellent hunting, fishing, and trapping. A large heron and egret rookery exists in the Fountain City vicinity. Much of the rich and diverse Fountain City Bay area is within the Whitman Wildlife Area (managed by the Wisconsin Department of Natural Resources). The Fish and Wildlife Service recommends that the Federal land within the overall boundaries of the Whitman Wildlife Area be transferred to the State of Wisconsin. The Thorp Wildlife Management Area is managed by the Minnesota Department of Natural Resources. One closed area provides waterfowl sanctuary during the hunting season.

Whitman Bottoms Floodplain Forest in Buffalo County is a 170-acre scientific area controlled by the Wisconsin Department of Natural Resources, Bureau of Wildlife Management. The Wisconsin Department of Natural Resources has designated Kammeroski Rookery at mile 734 as a State Natural Area.

CULTURAL RESOURCES

Known cultural resources within pool 5A are few. No historic properties are recorded for Minnesota. Only eight archeological sites have been recorded in the Minnesota portion of this pool. Most of these sites are burial mounds located outside of the floodplain. Within this area, 11 archeological sites are known in Buffalo County. Twenty-two known historic sites are in the Wisconsin part of this pool. All of these are known from inventory work conducted by the Wisconsin State Historical Society. The Fugina House in Fountain City, Wisconsin, is on the National Register of Historic Places.

RECREATION FACILITIES AND LAND USE ALLOCATIONS

Pool 5A has 11 boat accesses with 16 launching lanes and 430 parking spaces (GREAT I, 1980). It also has approximately 80 marina slips, 38 rental boats, 163 camping units, and 96 picnicking units. Ten dredged material disposal islands in the pool are used as undeveloped recreation areas. Merrick State Park in Wisconsin is the pool's only major park. Located between river miles 735 and 736, this park serves as a major access to the river from Wisconsin. It is a long, narrow park extending northward from Fountain City Bay with some additional area in the river bottoms. Merrick State Park is a very popular camping, picnicking, swimming, boating, and fishing attraction.

Most of the recreational boating activity occurs in the middle of the pool in conjunction with the dredged material disposal sites located there. The GREAT I aerial survey on September 5, 1976, revealed 10 beaching sites used by recreational boats in pool 5A. The heaviest concentration of beached boats occurred at mile 730.0L, mile 730.4L (site 5A.08), and mile 734.5L (site 5A.14). These beach sites accounted for nearly 80 percent of the beached boats observed in pool 5A. A total of 19 runabouts were observed at site 5A.14. Only one other site was observed to have more than two beached boats.

Field inspections of these sites for preparation of the Upper Mississippi River master plan supported the earlier findings of the GREAT I aerial survey. The location of site 5A.14 on State of Wisconsin land prevented the Corps from zoning the site for low-density recreation, although the plan recognized the site as the best and most popular beach area in pool 5A. The pool's other significant beach area, site 5A.08, located on Fish and Wildlife Service land, was delineated in the plan as a low-density recreation site.

Although there are no GREAT I-recommended actions for primitive camp/beach sites in pool 5A, sites 5A.08 and 5A.14 meet the design and selection criteria established by the GREAT I Recreation Work Group.

DEVELOPMENT NEEDS

Survey Results

Information regarding the recreational use of dredged material disposal areas was collected during the summer of 1977 (Upper Mississippi River Dredged Material Disposal Site Recreational Assessment, November, 1978). That report and the preceding section provide more complete discussions of this topic.

The survey found the following significant variations for pool 5A:

A significant relationship between river pool location and total cost exists for pool 5A, which had more users at both the low and high cost figures than expected.

Cost of travel to the river also had a significant relationship to pool location, with pool 5A having a higher proportion of users in the high travel-cost bracket.

Of those surveyed in pool 5A, 67 percent use lockages, although overall most visitors surveyed (68 percent) do not use lockages.

As a choice for put-in, "near favorite island" had a higher than expected group of no responses in pool 5A.

Origin of Trip of those Users Surveyed in Pool 5A

Site of Orgin	Percentage of Total
Winona, Minnesota	26
Wabasha, Minnesota	12
Merrick, Wisconsin	12
La Crosse, Wisconsin	9
Other Minnesota cities	9
Alma, Wisconsin	8

Lockage-Waiting Areas

A proposal for preparation of a problem appraisal report on the need for lockage-waiting areas was made in 1987. The study would explore problems with navigational safety due to congestion of commercial and recreational vessels at locks and dams and identify possible alternative solutions.

The GREAT I Study identified the need for some type of recreational craft lockage-waiting areas and made general recommendations about where such facilities should be located.

An earlier Corps Recreational Craft Locks Study (1978) evaluated four sites in the vicinity of lock and dam 5A for suitability as lockage-waiting areas. Two sites were recommended for development, one above and one below lock and dam 5A.

The upstream site is at mile 729.0R, in a cove about 2,700 feet upstream from the lock and dam. The adjacent land is a protective dike that rises about 11 feet above flat pool elevation. The site is Federal land within the Upper Mississippi National Wildlife and Fish Refuge. Wing dams exist between the site and the lock. The area is not accessible from land. Proposed development plans did not include provisions for sand fill and development at the site would not be affected by construction of the Iowa Vanes.

The downstream site is located on private land at mile 728.0L, approximately 2,200 feet below the lock and dam. The site has an existing sand beach and has historic use as a dredged material placement site. Present development plans do not call for use of additional dredged material for site development.

Both lockage-waiting sites would need additional evaluation, and the potential for the beneficial use of material would be examined.

Projected Deficiencies

The greatest projected deficiencies in pool 5A are for boat access launching lanes and adjacent parking, road access, swimming beaches, multipurpose trails, and hunting areas.

By the year 2000, approximately 850 additional parking spaces and 21 launching lanes will be required in the pool. By 2025, approximately 1,085 parking spaces and 28 launching lanes will be required. The needs for powerboat access are projected to be almost double those of fishing access needs.

The recreational use projections reflect the tremendous demand for recreatioral opportunities in the area of pool 5A. Data from the aerial survey of September 5, 1976, indicated an instantaneous open water boat use of approximately one boat per 50 acres, with an additional 50 boats pulled up on sandbars. This is relatively low density.

In planning future boat accesses, if a maximum standard of 1 boat per 20 acres were used (GREAT I, Space Standards, 1976) and if 10 percent of the boats were assumed to be in use at any one time, approximately 170 additional parking spaces and 4 launching lanes would be desirable. If the standard were lowered to 1 boat per 10 acres, approximately 690 additional parking spaces and 17 launching lanes would be required. The addition of approximately 170 additional parking spaces and 4 launching lanes appears to reflect the capacity of the resources in pool 5A better than higher densities.

Little is known, however, about the environmental and social/psychological impacts of increasingly dense recreational use. As additional development occurs, these impacts should be continuously monitored.

Additional camping units being developed at Bass Camp should meet the projected year 2025 demands. The existing camping use increasing camping capacity at Bass Camp will also affect the recreational boating on the river and further slightly decrease the recreation resource requirements.

Even though pool 5A appears to have adequate picnicking units, they are all located at Merrick Park in Wisconsin. Additional facilities in Minnesota are desirable.

RECOMMENDATIONS

Multipurpose trails and hunting represent regional demands. Some of this demand will be satisfied elsewhere in the region. Multipurpose trail deficiencies probably exist throughout the region, however. Some additional low-impact trails could probably be provided in Merrick State Park and in the Whitman Wildlife Area. Wisconsin should consider a trail joining Merrick and Perrot State Parks. The regional demand for hunting cannot be satisfied within pool 5A.

The following reccmmendations are in the Great I Report, Appendix G, Recreation Work Group:

1. Investigate the feasibility of expanding the camping, picnicking, boat access, parking, and beach facilities at Latsch Prairie Island Park.

2. The need for improved maintenance of the access channel into the Minnesota City Boat Club should be investigated (leased from Corps).

3. Encourage Bass Camp to expand its camping, boating access, parking, and picnicking facilities.

4. The Minnesota DNR should investigate the feasibility of establishing a public access at Bass camp.

5. The Wisconsin DNR should investigate the feasibility of additional trail developments in Merrick State Park and in Whitman Wildlife Area, and a system of interconnecting trails.

6. The Corps of Engineers should place dredged material and reshape the area at mile 737.7L to expand the beach facility. This area could be used as a "holding area" for those awaiting lockage and could provide additional primitive recreation facilities.

7. Redevelop the recreational access at mile 734 - Burleigh Slough Area.

8. The Corps of Engineers should further investigate the feasibility of developing a new beach area at mile 729.0R. This area would serve as a "lockage-waiting area."

APPENDIX E

DESIGN AND COST

APPENDIX E

DESIGN AND COST

No detailed design is available at the present time, except as indicated in the attached table which lists three possible configurations for the proposed Iowa Vanes. These three options are: driven piling, semi-modular units, or modular units.

Possible materials to be used in constructing the vanes are concrete highway barriers (Jersey barriers), steel piling with wooden frame and a reinforced mesh covering, and steel piling with metal coverings. Choice of materials may depend on the existing water depths varying from 21 feet in Betsy Slough to 32 feet in Wilds Bend.

Also, consideration should be given to placing incremental heights of vanes (build as conditions warrant or change with the vanes remaining in place). For instance, especially in Wilds Bend, the depth is substantial and maybe vanes of about 6 feet high could be placed as the channel cross section changes with each installation of vanes.

The semi-modular units would be difficult to place at the depths and velocities experienced at the proposed two sites. This same thought holds true for driven piling. The most likely option would probably involve a fully modular unit which could consist of something on the order of a concrete highway divider.

It will be necessary to develop a final design for the proposed Iowa Vanes installation in conjunction with the proposed movable bed modeling by Iowa Consultants.

5/27/87 CJS General Engineering

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Wild's Bend Alternative Comparison

Alt no.	Alternative	Description	Quantities cu.yds	constr. cost($5)	Ave. ann. Dredging cu.yds.	Dredging Reduct.(%) cu.yds.	New Dredge Quantities cu.yds./yr.	New Ann. Drdg cst($5)
1.	Do Nothing	no change in operation	0	0	28,000	0	0	$140,000
2.	Channel Cutoff	excavate a 300 ft. channel 12 ft below LCP, 6200 ft long with 3:1 side slopes the cut will parallel the railroad on the Wisconsin side	597,333	$2,986,665	28,000	9,800(35%)	18,200	$91,000
2A.	Channel Cutoff	same as above except for the location and length. Length will be about 5200 ft. The cut will be a curved and about 1600 ft off the railroad.	618,286	$3,091,430	28,000	7,000(25%)	21,000	$105,000
3.	Restore Pap's Slough	restore this channel as the main channel. The cross section of alternative 2 will be used for a length of about 8,500 ft.	517,944	$2,589,720	28,000	9,800(35%)	18,200	$91,000
4.	Overdredging Betsy Slough	dredge the 8,000 ft. channel to a 400 to 450 ft. wide channel bottom and 3:1 side slopes.	250,000	$1,250,000	30,000	0	30,000	$150,000
5.	Channel Structures	Training Structures in Betsy Slough (Iowa Vanes)	8,224sf	$164,480($20)	28,000	19,600(70%)	8,400	$42,000
6.	Revised Operation Plan	raise the flat pool elevation by 1 ft.	0	0	28,000	0	28,000	$140,000

NOTES:

Dredging: (1956 thru 1985)

	River Mile	Cu.yds/30yrs	Ave cu.yds/yr	# of Dredgings	Equipment (# of dredgings) Thompson	Hauser	contract	Depth below LCP
Head of Betsy Slough	731.0 to 732.0	485,300	16,177	16	8	7	1	11,12 & 13'
Wild's Bend	730.2 to 730.7	388,800	12,960	*15	9	4	0	11,12 & 13'
	TOTALS:	874,100	29,137	*31	17	11	1	

* No Equipment listed for 1971 and 1972

Wild's Bend
(Iowa Vanes)

Design Layout:

Media Conditions:	Betsy Slough	Wild's Bend
Piling Exposure (water)	1 to 6' (vertical)	1 to 12' (vertical)
Piling Embedment (river bottom)	5' (used as average)	5' (used as average)
Dimensions:		
Spacing	200' center to center	200' center to center
End to end spacing	176 to 192'	148 to 192'
Length	4 times the exposure (8' to 24')	4 times the exposure (4' to 52')
Top of Structure (El. 635.0)	15' below LCP	15' below LCP
Side to side spacing	80'	80'
Distance between riverbank & Vanes	90'	?
Change in ground elevations between Vanes	0 to 4'	0 to 9'
Length of project	1,600'	2,600'
Forces (7' high X 28' long vane)	2300# lift (sideways)11.7#/sf 470# drag (longitudinal) 2.4#/sf	2300# lift (sideways) 470# drag (longitudinal)

Three types of vane units: (* Experimental Project in St. Paul Dist.)

Type	Disadvantages	Advantages
1. Driven Piling (Continuous connected piling)	1. Construct under water 2. Permanent (no adjustment) 3. Disrupt navigation/recreation during contruction	1. None
2. Semi-modular units (Individual beams driven vertically like posts and modular panels slipped into position)	1. Beams driven under water 2. Partially permanent 3. Disrupt navigation/recreation during construction	1. Can remove panels, but no adjustment
3. Modular units (Two vanes constructed per unit)		1. Construct units on land 2. Can be permanent/semi-permanent/temporary in channel 3. Readily adjustable for any scour, deposition, bank erosion, flow movement,...etc. 4. No disruption of navigation/recreation during installation

COMMENTS: 1. The modular units are the logical choice at this time, especially when we compare the differing bank conditions of Betsy Slough & Wild's Bend.

* 1. Currently studied & tested in Iowa.
2. ED-H has report from Iowa.

APPENDIX F

FUTURE WORK

WILDS BEND CHANNEL IMPROVEMENT
POOL 5A - MISSISSIPPI RIVER
FOUNTAIN CITY, WISCONSIN
ALTERNATIVES REPORT

APPENDIX F

FUTURE WORK

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WILDS BEND CHANNEL IMPROVEMENT
POOL 5A - MISSISSIPPI RIVER
FOUNTAIN CITY, WISCONSIN
ALTERNATIVES REPORT

APPENDIX F

FUTURE WORK

This alternatives report was used to further study efforts with the State and Federal agencies involved in the Channel Maintenance Forum. The next step after completion of the alternatives report and coordination effort is a hydraulic model and detailed design study. Assuming favorable model and detailed design results, plus continued favorable coordination efforts, the Corps will propose a design development leading to construction. The next phase will involve the following efforts (subject to footnote on page F-5).

WORK REQUIRED

PROJECT MANAGEMENT

Project Management will address the presently recommended alternative 5 (Iowa Vanes) in detail, as well as other possible alternative solutions to the Wilds Bend navigation problems. Current criteria and policies will be used to design the recommended plan incorporating both nonstructural and structural measures as appropriate. The major work effort will be to develop a final design that best meets overall needs and to confirm the optimum scale of project development. As an integral part of the design, coordination will be maintained with the public and other agencies throughout all stages of the work. Preparation of a General Design Memorandum will be the specific responsibility of this work.

This design report will specify the recommended plan and plan alignment. The findings of the General Design Memorandum report will allow the proposed project to proceed into construction. The following work items are required to carry the project proposal through the design analysis stage.

ECONOMIC AND FINANCIAL ANALYSIS

Studies to evaluate project economics will include formulation of alternative project costs and benefits, screening and ranking of alternatives, benefit-cost analysis, and determination of risk and uncertainty related to project outcomes. Average annual costs, using current interest rates, will be determined within the St. Paul District office.

FOUNDATIONS AND MATERIALS

A geotechnical appendix will be necessary for future studies. The appendix will describe the main features of the selected alternative, foundation, topography, and geology of the area. Project features will be analyzed to see if they meet criteria and the analyses presented in the study analysis.

SURVEYS

Underwater surveys (soundings) along with shoreline surveys of adjacent land features will need to be taken during the first half of fiscal year 1988 in the proposed navigation channel area. In general, the entire navigation portion of the river between UMR mile 730 and UMR mile 731.5 should be surveyed and mapped. Survey data would then be drafted onto plates to a scale of 1 inch equals 50 feet. This topographic information would then become the basis for all subsequent hydraulic modeling and project design, especially for alignment of the vanes in respect to the radius of each curve.

REAL ESTATE

There are no lands involved in the placement of Iowa Vanes. Therefore, there are no real estate considerations for this project as proposed.

DESIGNS AND COST ESTIMATES

Detailed project designs for all alternative features will be developed. Such designs will be in accordance with accepted criteria and guidelines. Design work will also include drafting of all report charts, illustrations, and plates in accordance with drafting standards. A detailed estimate of first costs will be accomplished, including appropriate allowances for advance engineering, design, and contingencies. The estimates of first costs will reflect prevailing price levels for similar work in the area and be based on recent price information. An estimate of annual costs (including appropriate allowances for operation, maintenance, and scheduled replacement of major project features) will be prepared. These annual costs will be based on the interest rate prevailing at the time of report completion.

HYDRAULIC ANALYSIS

Further study of alternative 5 (Iowa Vanes) will require a movable bed model study. Such a study would likely require about $40,000. Iowa Vanes is a patent-pending concept developed by the Iowa Institute of Hydraulic Research (a division of the University of Iowa College of Engineering). A firm called Iowa Hydraulics Consultants, Inc., Iowa City, Iowa, has exclusive rights to proposals for design and installation of Iowa Vanes for erosion and sediment control. Any added detailed work involving the Iowa Vane concept will require the involvement of the Iowa Hydraulics Consultants firm.

ENVIRONMENTAL RESOURCES

Environmental studies will be undertaken to identify the impacts of the recommended alternative on the natural and human environment. Specific studies will be undertaken in the categories of natural resources, recreation resources, cultural resources, and social effects.

Natural Resources

A biological resources monitoring program will be initiated in conjunction with the proposed physical resources monitoring program. This study will gather base line data of existing floral and faunal conditions and determine if and how these conditions change as any changes occur to the physical environment.

Recreation

Recreation will be minimally affected by installation of Iowa Vanes at Wilds Bend. The proposed modifications are limited to the main channel river bottom and will not affect surface use.

Existing recreation facilities consist of several boat beaching and primitive camping areas adjacent to the main channel at river miles 730 - 730.5. These beaches were developed, and may be used in the future, as dredged material disposal sites. Part of the area has been identified as a low density recreation area and part is designated as an operations area. No dredged material is anticipated with this project. If there was dredged material, it should be carefully placed in order to maintain the quality of the existing shoreline for recreation use.

Social

Investigations conducted during future studies will analyze the social effects construction activities have on employment, community services, safety and health, noise and air pollution, and local transportation. The recommended alternative will also be evaluated for effects on other elements of the human environment consistent with Public Law 91-611, Section 122.

Cultural Resources

No archeological, historical, or architectural sites will be affected by the proposed placement of Iowa Vanes at Wilds Bend. In addition, no surveys will need to be conducted because no exposed land will be affected. Therefore, no additional cultural resource work will be required. However, any excess dredged material resulting from implementation of the selected alternative must be placed in an area that has been cleared for cultural resources. This clearance will require coordination, and possible surveys, depending upon the location of the proposed disposal area.

Idealized Work Schedule - Detailed Study[1]

Designation	Completion Date
Alternatives Report	Mar 1988
Complete Added Field Surveys	Sep 1988
Complete Hydraulic Analysis	Dec 1988
Complete Detailed Design	Feb 1989
General Design Memorandum	Mar 1989
Construction Start	Dec 1989

(1) This schedule will be delayed pending the outcome of the recommended hydraulic model study and review by other water resource agencies.

Cost for Detailed Design

Item	Amount
Preliminary Planning and Public Contacts	$ 20,000
Hydraulic Model	40,000
Hydrologic and Hydraulic Studies	25,000
Surveys and Mapping	10,000
Foundations and Materials	20,000
Design and Cost Estimates	35,000
Environmental and Cultural Studies	10,000
Socioeconomic and Recreation Studies	10,000
Real Estate	3,000
Report Preparation	15,000
Supervision and Administration	12,000
Total: Detailed Study	$200,000

APPENDIX G

DREDGING HISTORY AND DISPOSAL

APPENDIX G

DREDGING HISTORY AND DISPOSAL

This appendix has three basic parts:

1. Summary and graphs for Pool 5A from Construction-Operations Division.
2. Extract from "Dredged Material Placement Reconnaissance Report - Pool 5A - January 1984."
3. Dredged Material Disposal.

PART I

SUMMARY AND GRAPHS FOR POOL 5A

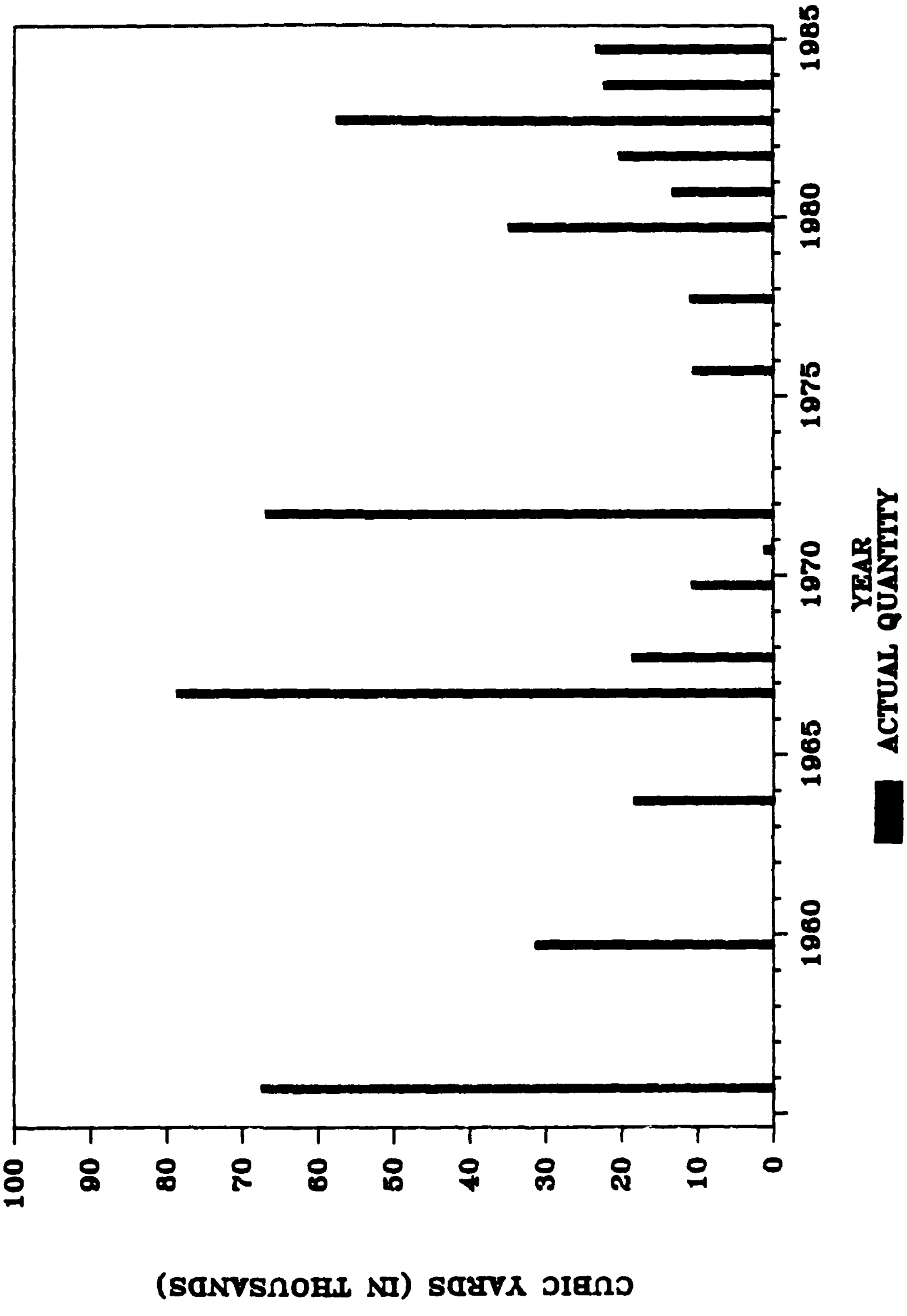
FROM CONSTRUCTION-OPERATIONS DIVISION

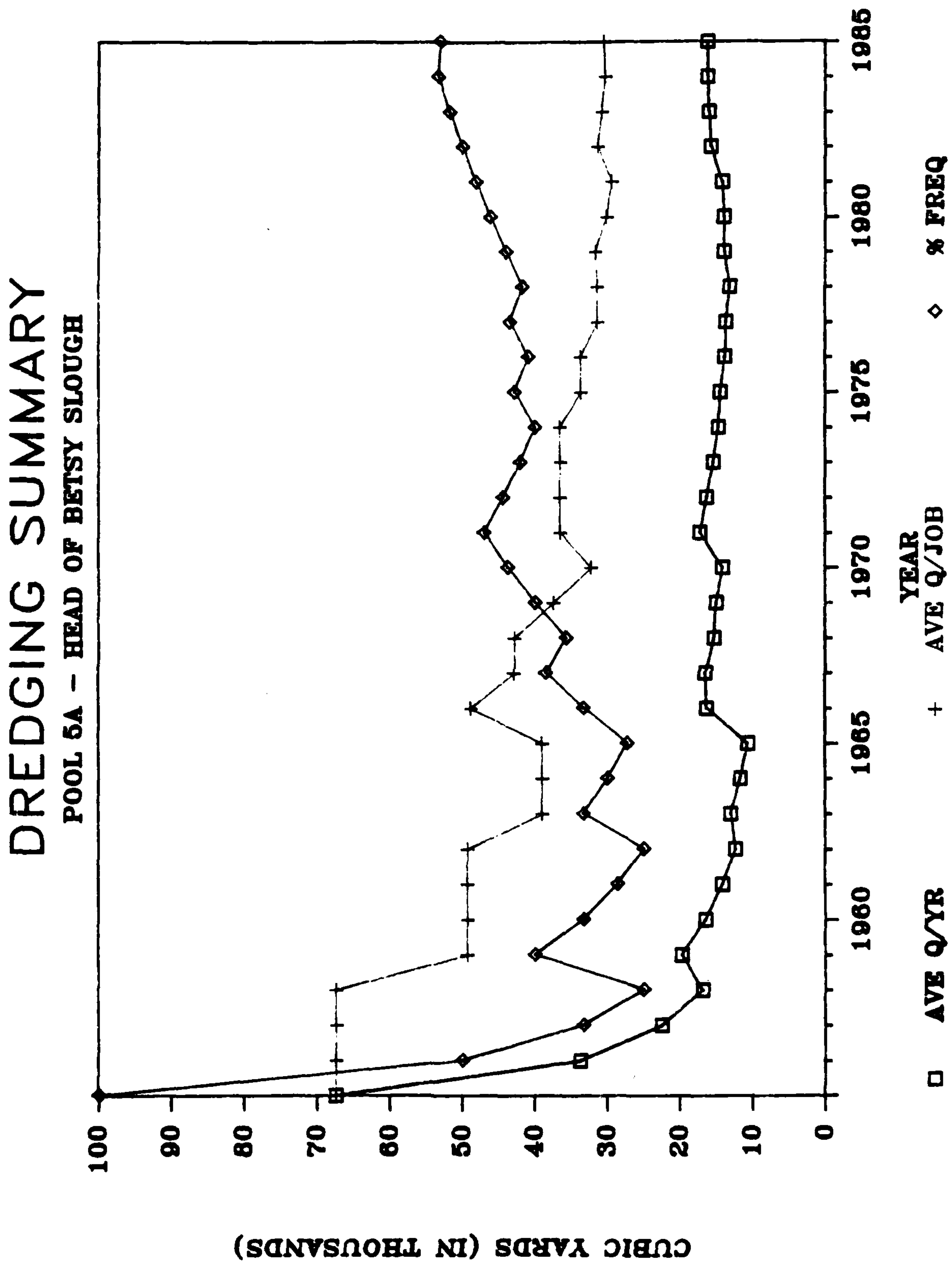
The data presented on the following tables and graphs is based on actual records of dredging and placement in Pool 5A for the period 1956-1980.

The frequency of dredging is defined as the number of times, stated as a percentage, that the site has been dredged during the historic period (i.e., 10 times in the past 25 years is 40 percent).

DREDGING SUMMARY

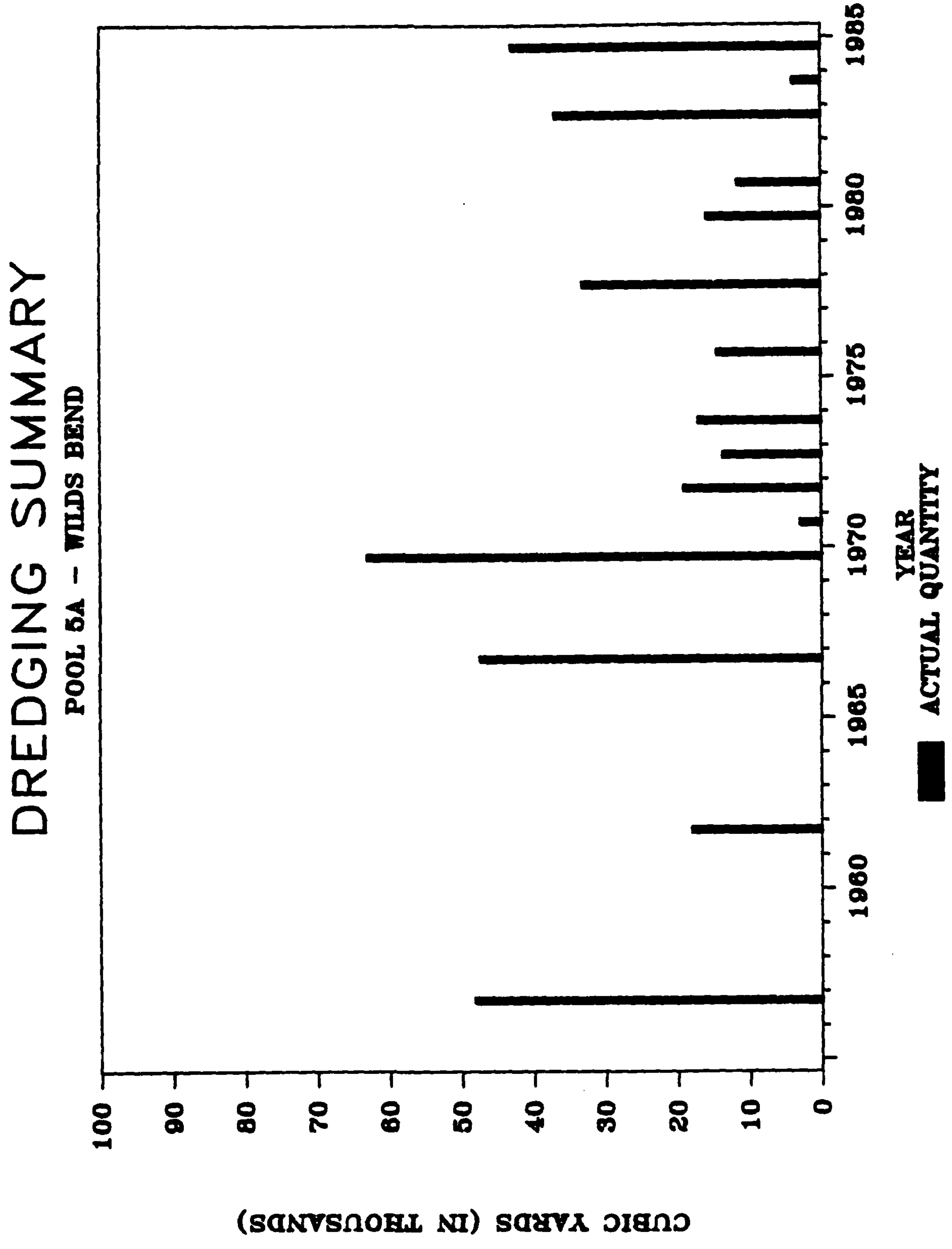
POOL 5A - HEAD OF BETSY SLOUGH

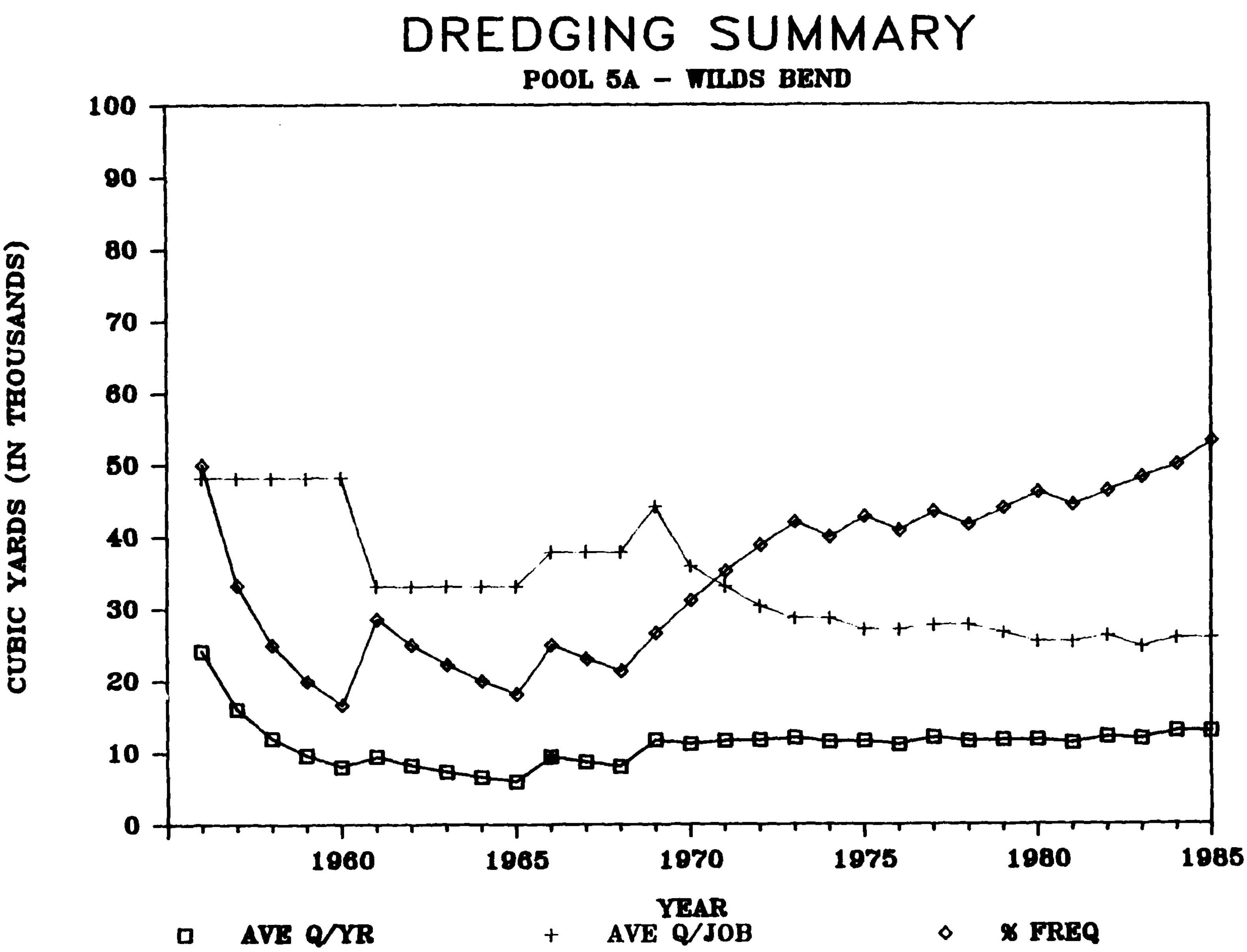



DREDGING SUMMARY
POOL 5A - HEAD OF BETSY SLOUGH
CUBIC YARDS (IN THOUSANDS)
100
90
80
70
60
50
40
30
20
10
0
1960
1965
1970
1975
1980
1985
YEAR
□ AVE Q/YR
+ AVE Q/JOB
◇ % FREQ

POOL 5A
DREDGING SUMMARY FOR HEAD OF BETSY SLOUGH
RIVER MILE 731.0 - 732.0

YEAR	ACTUAL QUANTITY	AVERAGE QUANTITY PER YEAR	AVERAGE QUANTITY PER JOB	DREDGING FREQUENCY (%)	DEPTH FROM LCP	PERCENT FROM UPPER CUT	PERCENT FROM LOWER CUT	EQUIPMENT	PLACEMENT SITE
1956	67.4	67.4	67.4	100%		100		GH-THOMPSON	
1957		33.7	67.4	50%					
1958		22.5	67.4	33%					
1959		16.9	67.4	25%					
1960	31.3	19.7	49.4	40%	13'	100		GH-THOMPSON	732.4 RB, 731.6 RB
1961		16.5	49.4	33%					
1962		14.1	49.4	29%					
1963		12.3	49.4	25%					
1964	18.3	13.0	39.0	33%	13'	100		GH-THOMPSON	731.4 RB
1965		11.7	39.0	30%					
1966		10.6	39.0	27%					
1967	78.6	16.3	48.9	33%	13'	100		GH-THOMPSON	732.0 LB, 731.4 RB
1968	18.6	16.5	42.8	38%	13'	50	50	GM-HAUSER	
1969		15.3	42.8	36%					
1970	10.7	15.0	37.5	40%	13'	100		GM-HAUSER	
1971	1.1	14.1	32.3	44%		100		GM-HAUSER	
1972	66.8	17.2	36.6	47%	13'		100	GH-THOMPSON	731.4 RB
1973		16.3	36.6	44%					
1974		15.4	36.6	42%					
1975		14.6	36.6	40%					
1976	10.5	14.4	33.7	43%	11'		100	GH-THOMPSON	731.8 LB
1977		13.8	33.7	41%					
1978	10.9	13.7	31.4	43%	12'		100	GM-HAUSER	732.0 LB
1979		13.1	31.4	42%					
1980	34.8	14.0	31.7	44%	11'	35	65	GM-HAUSER	732.0 LB, 731.8 LB, 731.3 LB
1981	13.2	13.9	30.2	46%	12'		100	GM-HAUSER	732.0 LB
1982	20.2	14.2	29.4	48%	11'/12'	20	80	CM-ACTON	731.8 LB
1983	57.5	15.7	31.4	50%	12'		100	GH-THOMPSON	730.5 LB
1984	22.2	15.9	30.8	52%	12'		100	G-WAT/HAUSER	730.5 LB, 731.8 LB
1985	23.2	16.2	30.3	53%	12'		100	GH-THOMPSON	730.5 LB


DREDGING SUMMARY
POOL 5A - WILDS BEND
CUBIC YARDS (IN THOUSANDS)
0
10
20
30
40
50
60
70
80
90
100
1960
1965
1970
1975
1980
1985
YEAR
ACTUAL QUANTITY



DREDGING SUMMARY
POOL 5A - WILDS BEND
CUBIC YARDS (IN THOUSANDS)
100
90
80
70
60
50
40
30
20
10
0
1960
1965
1970
1975
1980
1985
YEAR
AVE Q/YR
AVE Q/JOB
% FREQ

POOL 5A

DREDGING SUMMARY FOR WILDS BEND
RIVER MILE 730.2 - 730.7

YEAR	ACTUAL QUANTITY	AVERAGE QUANTITY PER YEAR	AVERAGE QUANTITY PER JOB	DREDGING FREQUENCY (%)	DEPTH FROM LCP	EQUIPMENT	PLACEMENT SITE
1956							
1957	48.2	24.1	48.2	50%	13'	GH-THOMPSON	730.6 LB, 730.8 LB
1958		16.1	48.2	33%			
1959		12.1	48.2	25%			
1960		9.6	48.2	20%			
1961		8.0	48.2	17%			
1962	18.1	9.5	33.2	29%	13'	GH-THOMPSON	730.6 LB
1963		8.3	33.2	25%			
1964		7.4	33.2	22%			
1965		6.6	33.2	20%			
1966		6.0	33.2	18%			
1967	47.5	9.5	37.9	25%	13'	GH-THOMPSON	730.5 LB
1968		8.8	37.9	23%			
1969		8.1	37.9	21%			
1970	63.1	11.8	44.2	27%	13'	GH-THOMPSON	730.3-730.7 LB
1971	3	11.2	36.0	31%			
1972	19.1	11.7	33.2	35%			
1973	13.7	11.8	30.4	39%	13'	GH-THOMPSON	730.5 LB, 730.5 RB
1974	17.1	12.1	28.7	42%	11'	GH-THOMPSON	730.5 LB
1975		11.5	28.7	40%			
1976	14.5	11.6	27.1	43%	11'	GH-THOMPSON	730.5 LB
1977		11.1	27.1	41%			
1978	33.1	12.1	27.7	43%	11'/13'	G-WAT/DUB/HAUS	730.5 LB, 732.0 LB
1979		11.6	27.7	42%			
1980	15.9	11.7	26.7	44%	11'	GM-HAUSER	732.0 LB, 731.8 LB
1981	11.6	11.7	25.4	46%	12'	GM-HAUSER	731.8 LB
1982		11.3	25.4	44%			
1983	36.9	12.2	26.3	46%	12'	GH-THOMPSON	730.5 LB
1984	4	11.9	24.7	48%	12'	GM-HAUSER	731.8 LB
1985	43	13.0	25.9	50%	12'	GH-THOMPSON	730.5 LB

PART II

EXTRACT FROM

DREDGED MATERIAL PLACEMENT RECONNAISSANCE REPORT

POOL 5A - JANUARY 1984

US Army Corps
of Engineers
St. Paul District

Dredged Material Placement Reconnaissance Report Pool 5A

Great I Implementation
9 Foot Channel Project
Upper Mississippi River Mile
728.5-738.1

January 1984

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Pool 5A
GREAT I Implementation
9-Foot Channel Project
Upper Mississippi River Mile
728.5 - 738.1

INTRODUCTION

The St. Paul District, U.S. Army Corps of Engineers, is in the process of implementing the GREAT I Channel Maintenance Plan (CMP) for the Upper Mississippi River. The GREAT I CMP consists of a series of recommended placement sites for the material dredged to maintain the 9-foot navigation channel during the 40-year period from 1986 to 2025. This reconnaissance report addresses the feasibility of the GREAT I recommendations along with alternative placement plans thought to have merit by the District.

This report specifically addresses dredge cuts and dredged material placement sites in Pool 5A. GREAT I CMP sites, alternative placement sites, and alternative placement methods are evaluated with consideration given to economic, environmental, and social values, as recommended in the public notice letter for the final GREAT I and II reports. Consideration is also given to aesthetic and recreational factors, as recommended in GREAT I, Volume I. Appendixes A thru G in the back of this report contain further information as to the details/evaluations of the various placement sites and cuts 1, 2, 3, 4, 5 and 6. The intent of this report is to identify a long-term dredged material placement plan for Pool 5A that minimizes any adverse environmental impacts, reflects sound engineering design, and is operationally implementable.

GENERAL DESCRIPTION

Lock and Dam 5A is located 3 miles above Winona at river mile 728.5. Of all the pools below Pool 1, Pool 5A has the least water area, the least overall pool area, and the least shoreline that is accessible by land. There are no tributary rivers in Pool 5A. The principal features of the pool are summarized in the following table.

Table 1
Principal Features of Pool 5A

Length of pool	9.6 river miles
River mile limits	728.5 - 738.1
Average pool elevation	651.0 feet
Pool surface area	6,140 acres
Shoreline miles (meandering outer perimeter)	35 miles

RECREATION

Pool 5A has ten dredged material disposal islands which are used as undeveloped recreation areas. Most of the recreational boating activity occurs in the middle of the pool in connection with the dredged material disposal sites located there. The heaviest concentration of beached boats occurs at sites 5A.08 and 5A.14. These beach sites account for nearly 80 percent of the beached boats observed in pool 5A by GREAT.

CULTURAL RESOURCES

As of November 17, 1982, no properties listed on or eligible for inclusion on the National Register would be impacted by any of the proposed alternatives at Sites 5A.08, 5A.14, 5A.23, 5A.25 or 5A.32. Also, there are no known sites of archaeological, architectural or historical significance that would be impacted by any of the alternatives. Because of the probability that Sites 5A.14 and 5A.32 may contain previously unknown archaeological sites, a cultural resource survey was conducted at these two sites. Since no cultural resources were located at either area, none would be impacted by any of the proposed alternatives.

NATURAL RESOURCES

Fish and wildlife habitat in the pool is generally very good. The Fountain City Bay area and the extensive backwater between Fountain City, Wisconsin, and Minnesota City, Minnesota, provide excellent fishing, hunting, and trapping. There is a large heron and egret rookery in the Fountain City area. Much of the pool lies within the Winona District of the Upper Mississippi River Wildlife and Fish Refuge.

COMMERCIAL NAVIGATION

There are no commercial navigation facilities in Pool 5A.

DREDGE CUTS

GREAT I identified six historic dredge cut locations in Pool 5A (See Figure 1). In this report, cut 1 (upper approach to L/D 5A) was eliminated from consideration because a review of the past jobs and a recent hydraulic analysis indicated that future maintenance dredging will not be required. The characteristics of the six cuts are summarized in the following table.

Table 2

Dredge Cut Summary
Pool 5A

Dredge Cut	River Mile Location	Estimated No. of Jobs	MPFWG Quantity (Cubic Yards) 1986-2025	Average Quantity Per Job (Cubic Yards)
1. Upper Approach to L/D 5A	728.5-729.5	10	*451,500	45,150
2. Wild's Bend	730.0-730.8	14	276,000	19,800
3. Head at Betsy Slough	731.8-732.2	14	461,000	32,900
4. Fountain City	733.4-733.9	12	407,500	34,000
5. Island 58	734.0-735.2	20	724,000	36,200
6. Lower Approach to L/D 5	737.7-738.1	2	49,500	24,800
			1,918,000	

* Eliminated

The total projected dredge cut quantity of 1,918,000 cubic yards from cuts 2, 3, 4, 5 and 6 is used in this report for the 40-year maintenance period representing the Most Probable Future with GREAT (MPFWG). MPFWG quantities are based on the assumption that the implementation of GREAT I recommendations will reduce future dredging quantities from historic levels. Sizing and impact evaluations of dredged material placement sites in this report are based on MPFWG projected quantities.

DREDGED MATERIAL PLACEMENT SITES

GREAT I DREDGED MATERIAL PLACEMENT (DMP) SITES.

GREAT I selected six DMP sites in Pool 5A (5A.36, 5A.32, 5A.25, 5A.23, 5A.14 and 5A.08). The maximum site development dimensions of these sites, as presented in the GREAT report, are listed in Table 3, under GREAT. Also listed, under Present, are the current maximum site development dimensions required and available for alternative material placement plans detailed in subsequent sections of this report.

Table 3

GREAT I DMP Sites
Pool 5A

DMP Site	Maximum DMP Site Development Dimensions					
	Capacity (CY)		Area (Acres)		Height (Ft)	
	GREAT	Present	GREAT	Present	GREAT	Present
5A.32	1,366,000	764,500	34	34	25	25
5A.25	220,000	**	6	--	25	--
5A.36	81,000	***	2	--	25	--
5A.23	296,000	****	7	--	25	--
		363,500		18		25
*5A.14	775,000	1,131,500	32	36	15	25
*5A.08	296,000	276,000	9	10	20	25

*GREAT I designated as a temporary site only.
**Beneficial use site only (4.0 acres).
***Site 5A.36 could be used in lieu of 5A.23 as a beneficial use site only.
****Beneficial use site only (2.0 acres).

NOTES: (Dimensions as evaluated by alternatives in this report).

GREAT I area computations worked with cube volumes and no side slope.

The GREAT I DMP sites are described in more detail in the following paragraphs.

Site 5A.32 - Site 5A.32 is a permanent placement site, located adjacent to Fountain City between the Burlington Northern Railroad tracks and Highway 35 at river mile 732.0 LB (see Figure 2). Vegetation at the site consists primarily of bottomland hardwoods and aquatic vegetation. This undeveloped site is currently used by fish and wildlife as a waterfowl nesting and fish spawning area. Potential uses of the site include industrial development and limited recreation. The site owned by the city of Fountain City has not been used for direct placement, but the city has done some filling with dredged material hauled from a nearby stockpile site. In this report, site 5A.32 is also considered a beneficial use site as well as a permenent placement site.

Site 5A.25 - Site 5A.25 is a permanent placement site, located adjacent to site 5A.32 at river mile 732.0 LB (see Figure 3). Vegetation at the site is predominantly bottomland hardwoods and willows. The site is currently used for dredged material placement and is privately owned. In this report, site 5A.25 is considered only as a beneficial use site because of its limited size for any permanent placements.

Site 5A.14 - Site 5A.14 is a temporary placement site, located adjacent to the navigation channel on the left descending bank at river mile 734.5 LB (see Figure 4). The site is partially bottomland hardwoods and partially old dredged material. Existing uses of the site include dredged material placement, turtle nesting, and fish spawning. In addition, this report also evaluates this federally owned site for use as a permanent placement site.

Site 5A.23 - Site 5A.23 (Bass Camp) is a permanent placement site, located about one-half mile downstream from Lock and Dam 5 on the right descending bank at river mile 737.5 RB (see Figure 5). Vegetation at the site is predominantly bottomland hardwoods. The site is currently used by fish and wildlife as a waterfowl nesting and fish spawning area. A privately owned and operated campground is located adjacent to the dredged material placement area. The privately owned site has had limited use historically. In this report, site 5A.23 is considered as either a beneficial use site only (5A.36 may be used in lieu of 5A.23) or both a beneficial use and permanent placement site when the dredging quantity exceeds the actual beneficial use.

Site 5A.36 - Site 5A.36 is a permanent placement site, located adjacent to the lower guide wall of Lock and Dam 5 at river mile 738.1 RB (see Figure 6). The site is partially bottomland hardwoods and partially old dredged material. Fish and wildlife use of the site is considered minimal. This federally owned site is considered a beneficial use site only, which may be used in lieu of site 5A.23 when the actual beneficial use exceeds the dredging quantity and there is no permanent placement.

Site 5A.08 - Site 5A.08 is a temporary placement site, located adjacent to the navigation channel on the left descending bank at river mile 730.5 LB (see Figure 7). Vegetation at the site consists of bottomland hardwoods, willows, and grasses. The federally owned site is currently used by fish and wildlife as a turtle nesting, fish spawning and waterfowl nesting area. In addition, this report also eveluates this site for use as a permanent placement site.

ALTERNATIVE DREDGED MATERIAL PLACEMENT (DMP) SITES

No other dredged material placement sites are recommended in this area.

BENEFICIAL USE

Placing dredged material at locations where it would or could be used beneficially was a primary objective of the GREAT I study. Beneficial use of dredged material is divided into two basic categories: active, which is removed from the site, and passive, which is left permanently for potential site development or enhancement.

The GREAT I report projected a total active beneficial use demand of 104,800 cubic yards for Pool 5A with 40,000 cubic yards at sites 5A.25 and 5A.32 and 64,800 cubic yards at sites 5A.23 and 5A.36. The primary users of the dredged materials are the city of Fountain City together with Milton and Buffalo Townships at site 5A.23 and 5A.32, Bass Camp at site 5A.23 and Winona County and Minnesota City at site 5A.23 and 5A.36. On the basis of the St. Paul District's past experience and survey data from a 1982 marketing study, these projections appear to be unrealistically low. The most recent information indicates an active beneficial use demand for approximately 380,000 cubic yards of material from sites 5A.25 and 5A.32 and 410,000 cubic yards from sites 5A.23 and 5A.36 for a total of 790,000 cubic yards. These revised beneficial use projections are considered more realistic and are, therefore, used in the analysis of the alternative dredged material placement plans.

In addition to active beneficial use, up to 764,500 cubic yards of passive beneficial use has been projected for site 5A.32 and 363,500 cubic yards for site 5A.23 for a total of up to 1,128,000 cubic yards. Neither site 5A.25 nor 5A.36 are considered passive beneficial use sites because there is no area compatible for permanent placement of the dredged material. Sites 5A.08 and 5A.14 have no access for land vehicles and are, therefore, not considered active or passive beneficial use sites.

ALTERNATIVE DEVELOPMENT

Nine alternative channel maintenance plans (A, A1, B, C, D, E, F, G and H) were formulated for Pool 5A based on dredged cuts 2, 3, 4, 5 and 6 along with the dredged material placement sites discussed previously. Alternatives A and A1 basically follow the GREAT I recommended plan, and the seven remaining alternatives (B, C, D, E, F, G and H) were formulated by the St. Paul District. The following paragraphs first describe the GREAT I Channel Maintenance Plan (CMP). Then each alternative plan (A, A1, B, C, D, E, F, G and H) is described in further detail and summarized in Tables 4 and 5. The quantity on site (or required site capacity), fill area, and pile height data shown in Table 4 for the GREAT I DMP sites was developed by the St. Paul District and may vary from that shown in the discussion of GREAT I DMP sites in Table 3. This can be attributed to the fact that the GREAT I data represents potential or existing site dimensions; whereas, data in Table 4 represents actual site dimensions required based on the amount of dredged material to be placed at each site for each alternative. A summary description of the principal economic, environmental, hydraulic, cultural, recreational and social effects follows each alternative description. More detailed information can be found in Appendixes A through G.

GREAT I CHANNEL MAINTENANCE PLAN (CMP)

GREAT I selected four permanent DMP sites, 5A.23, 5A.25, 5A.32, and 5A.36, to accommodate the placement of dredged materials from cuts 1, 2, 3, 4, 5 and 6. Sites 5A.08 and 5A.14 with capacities of 296,000 and 775,000 cubic yards, respectively, were also selected as temporary sites for the placement of dredged material from cuts 2 and 4 and 5, respectively. The report indicates that dredged material must be removed periodically from site 5A.14 and removed to retain the capacity at site 5A.25.

GREAT I projected an overall dredged quantity from cuts 1, 2, 3, 4, 5 and 6 of 2,369,500 cubic yards. An active beneficial use quantity of 40,000 cubic yards was projected at sites 5A.25 and 5A.32 together with 64,800 cubic yards at sites 5A.23 and 5A.36 for an overall total of 104,800 cubic yards. The overall net quantity to be permanently placed is the difference between the MPFWG quantity and the total active beneficial use quantity of 2,264,700 cubic yards.

In summary, sites 5A.25 and 5A.32, with capacities of 220,000 and 1,366,000 cubic yards, respectively, (total of 1,586,000) would receive 407,500 and 461,000 cubic yards of dredged material from cuts 4 and 3, respectively, and 451,500 and 276,000 cubic yards at both sites from cuts 1 and 2 for a total of 1,596,000 cubic yards. With a beneficial use of 40,000 cubic yards from the two sites, the net permanent placement of 1,556,000 cubic yards of dredged material from cuts 1, 2, 3 and 4 could be accommodated at sites 5A.25 and 5A.32. Sites—5A.23 and 5A.36, with capacities of 296,000 and 81,000 cubic yards, respectively, (total of 377,000) would receive 49,500 cubic yards at site 5A.23 and 724,000 cubic yards from cut 5 at both sites for a total of 773,500 cubic yards. With a beneficial use quantity of 64,800 cubic yards at the two sites, the net permanent placement quantity of 708,700 cubic yards cannot be accommodated by the two sites (5A.23 and 5A.36). The final dredged quantities that would be permanently accommodated and available for active beneficial use are as follows: 1,933,000 cubic yards would be permanently placed (1,556,000 cubic yards at 5A.25 and 5A.32 and 377,000 cubic yards at sites 5A.23 and 5A.36) and the active beneficial use quantity of 104,800 cubic yards (40,000 cubic yards at sites 5A.25 and 5A.32 and 64,800 at sites 5A.23 and 5A.36). These final quantities vary from the overall because of the dispersion of the quantities for the four site capacities, the six dredge cuts and two active beneficial use demands.

In final, sites 5A.25 and 5A.32 could accommodate cuts 1, 2, 3 and 4 with 30,000 cubic yards capacity remaining, and sites 5A.23 and 5A.36 cannot accommodate cuts 5 and 6 by a deficient of 331,700 cubic yards. Therefore, additional capacity is required to accommodate cut 5 or the combination of cuts 5 and 6.

ALTERNATIVE A

Description. This alternative is basically the GREAT I CMP for dredged material placement from Pool 5A. Sites 5A.32 and 5A.23 serve as the primary placement sites for all cuts (2 thru 6). The projected 764,500 cubic yards of dredged material from cuts 2, 3 and part of 4 would be permanently placed at site 5A.32. An area of 34 acres would be filled with material piled to a height of 15 feet at this site. A total of 773,500 cubic yards of material from cuts 5 and 6 would be placed at site 5A.23. Of the 773,500 cubic yards of material, 363,500 cubic yards would permanently remain on the site, and 410,000 cubic yards would be removed for beneficial use. An area of 18 acres would be filled with material piled to a height of 15 feet at this site. The remaining 380,000 cubic yards of material from cut 4 would be placed at site 5A.25. Material placed at this 4-acre site would be removed by beneficial use. Material from cuts 2 and 3 would be placed at site 5A.32 by direct hydraulic dredging methods. A small portion of cut 4 (27,500 cy) would be mechanically dredged, unloaded at an in-water rehandling site, and then hydraulically placed at site 5A.32. The larger remaining portion of cut 4 (380,000 cy) would be mechanically dredged and placed at site 5A.25. Material from cut 5 would be mechanically dredged and placed at site 5A.23. Cut 6 material would be placed at site 5A.23 by direct hydraulic methods.

Economic. This alternative is the third most expensive alternative with at total cost of $9,411,767 or $447,273 (5.0%) more than alternative C. Alternative A is more costly than alternative C due, in part, to the mechanical dredging of cuts 4 and 5 in lieu of the direct hydraulic method used in alternative C. Alternative A does, however, have the lowest site requirement costs.

Environmental. At sites 5A.32 and 5A.23, 26 acres of bottomland hardwood, 6 acres of shallow marsh, and 20 acres of shallow aquatic habitat would be affected. Localized temporary increases in turbidity and suspended solids would occur during periods of in-water rehandling.

Cultural. No effect is expected.

Social. There would be potential impacts (aesthetic, traffic, land values) on the residential area adjacent to site 5A.32.

Recreation. There would be potential for expansion of the private recreational facility at site 5A.23.

Hydraulic. No appreciable effect on water surface profiles, velocities, and flow distribution is expected.

ALTERNATIVE A1

Description. This plan basically follows alternative A, the GREAT I CMP. It varies only in that dredged material placed at sites 5A.32 and 5A.23 is piled to a height of 25 feet in lieu of the 15-foot pile height used in alternative A. This increase in turn reduces the total acreage to 22 acres at site 5A.32 and to 12 acres at site 5A.23.

Economic. This alternative is the second most expensive alternative with a total cost of $9,503,807 or $539,313 (6.0%) more than alternative C. Alternative A1 is more costly than alternative C due, in part, to the mechanical dredging of cuts 4 and 5 in lieu of the direct hydraulic method used in alternative C.

Environmental. At sites 5A.32 and 5A.23, 20 acres of bottomland hardwood, 4 acres of shallow marsh, and 10 acres of shallow aquatic habitat would be affected. Localized temporary increases in turbidity and suspended solids would occur during periods of in-water rehandling.

Cultural. No effect is expected.

Social. It is possible that developable property would be created for Fountain City. There would be potential impacts (aesthetic, traffic, land values) on the residential area adjacent to site 5A.32.

Recreation. There would be potential for expansion of the private recreational facility at site 5A.23.

Hydraulic. No appreciable effect on water surface profiles, velocities, and flow distribution is expected.

ALTERNATIVE B

Description. This alternative involves the use of sites 5A.32, 5A.14 and 5A.23 for placement of dredge material from pool 5A. The projected 737,000 cubic yards of dredge material from cuts 2 and 3 would be placed at site 5A.32. Of this, 380,000 cubic yards would be removed for beneficial use, and 357,000 cubic yards would permanently remain on the site. An area of 17 acres would be filled with material piled to a height of 15 feet at this site. At site 5A.14, an area of 13 acres would be filled to a height of 25 feet to permanently accommodate 407,500 cubic yards of dredge material from cut 4. A total of 773,500 cubic yards of material from cuts 5 and 6 would be placed at site 5A.23. Of this, 410,000 cubic yards would be removed for beneficial use, and 363,500 cubic yards would permanently remain on the site. An area of 18 acres would be filled with material piled to a height of 15 feet at this site. Material from cuts 2 and 3, cut 4 and cut 6 would be placed at sites 5A.32, 5A.14 and 5A.23, respectively, by direct hydraulic methods. Material from cut 5 would be mechanically dredged and placed at site 5A.23.

Economic. This alternative has a total cost of $9,214,386 or $249,892 (2.8%) more than alternative C. Alternative B is more costly than alternative C due, in part, to the mechanical dredging of cut 5 in lieu of the direct hydraulic method used in alternative C.

Environmental. At sites 5A.32, 5A.[illegible], and 5A.14, 13 acres of revegetating dredged material, 25 acres of bottomland hardwood, 3 acres of shallow marsh, and 7 acres of shallow aquatic habitat would be affected. Effluent discharges from site 5A.14 would occur during some hydraulic dredging events.

Cultural. No effect is expected.

Social. Creation of developable property for Fountain City is possible. There would be potential impacts (aesthetic, traffic, land values) on the residential area adjacent to site 5A.32.

Recreation. There would be potential for expansion of the private recreational facility at site 5A.23. Adverse impacts on 600 feet of beach at site 5A.14 are possible.

Hydraulic. No appreciable effect on water surface profiles, velocities, and flow distribution is expected.

ALTERNATIVE C

Description. This alternative involves the use of sites 5A.32, 5A.14 and 5A.23. A total of 737,000 cubic yards of material from cuts 2 and 3 would be placed at site 5A.32. Of this, 380,000 cubic yards would be removed for beneficial use, and 357,000 cubic yards would permanently remain on the site. An area of 17 acres would be filled with dredge material piled to a height of 15 feet. At site 5A.14, an area of 36 acres would be filled with material piled to a height of 25 feet. This site would permanently accommodate 1,131,500 cubic yards of dredge material from cuts 4 and 5. The projected 49,500 cubic yards of material from cut 6 would be placed at site 5A.23. Material placed at this 2-acre site would ultimately be removed by beneficial use. Site 5A.36 may be used in lieu of site 5A.23 as a beneficial use site. All material would be placed at its designated site by direct hydraulic methods.

Economic. This alternative is the least expensive alternative with a total cost of $8,964,494. The use of direct hydraulic dredging for all cuts is a contributing factor to this alternative's cost effectiveness.

Environmental. At sites 5A.32 and 5A.14, 26 acres of revegetating dredged material, 19 acres of bottomland hardwood, 3 acres of shallow marsh, and 7 acres of shallow aquatic habitat would be affected. Effluent discharges from site 5A.14 would occur during some hydraulic dredging events.

Cultural. No effect is expected.

Social. Creation of developable property for Fountain City is possible. There would be potential impacts (aesthetic, traffic, land values) on the residential area adjacent to site 5A.32.

Recreation. Adverse impacts on 1,800 feet of beach at site 5A.14 are possible.

Hydraulic. No appreciable effect upon water surface profiles, velocities, and flow distribution is expected.

ALTERNATIVE D

Description. This alternative involves the use of sites 5A.08, 5A.32, 5A.14 and 5A.23. At site 5A.08, an area of 10 acres would be filled with material piled to a height of 25 feet. This site would permanently accommodate 276,000 cubic yards of dredge material from cut 2. The projected 461,000 cubic yards of dredge material from cut 3 would be placed at site 5A.32. Of this, 380,000 cubic yards would be removed for beneficial use, and 81,000 cubic yards would permanently remain on the site. This material would be placed on a 4-acre area and piled to a height of 15 feet. A total of 1,131,500 cubic yards of material from cuts 4 and 5 would be permanently placed at site 5A.14. An area of 36 acres would be filled with dredge material piled to a height of 25 feet. The projected 49,500 cubic yards of material from cut 6 would be placed at site 5A.23. Material placed at this 2-acre site would ultimately be removed by beneficial use. Site 5A.36 may be used in lieu of site 5A.23 as a beneficial use site. All material would be placed at its designated site by direct hydraulic methods.

Economic. This alternative is the third least expensive alternative with a total cost of $9,038,600 or $74,106 (0.8%) more than alternative C. Alternative D is more costly than alternative C due to the use of an additional site (5A.08).

Environmental. At sites 5A.32, 5A.14, and 5A.08, 30 acres of revegetating dredged material, 14 acres of bottomland hardwood, 1 acre of shallow marsh, and 1 acre of shallow aquatic habitat would be affected. Effluent discharges from sites 5A.14 and 5A.08 would occur during some hydraulic dredging events.

Cultural. No effect is expected.

Social. Creation of developable property for Fountain City is possible. There would be potential impacts (aesthetic, traffic, land values) on the residential area adjacent to site 5A.32.

Recreation. Adverse impacts on 2,300 feet of beach at sites 5A.14 and 5A.08 are possible.

Hydraulic. No appreciable effect upon water surface profiles, velocities, and flow distribution is expected.

ALTERNATIVE E

Description. This alternative involves the use of sites 5A.08, 5A.32, 5A.14 and 5A.23. At site 5A.08, an area of 10 acres would be filled with material piled to a height of 25 feet. This site would permanently accommodate 276,000 cubic yards of dredge material from cut 2. The projected 461,000 cubic yards of dredge material from cut 3 would be placed at site 5A.32. Of this, 380,000 cubic yards would be removed for beneficial use, and 81,000 cubic yards would permanently remain on the site. This material would be placed on a 4-acre area and piled to a height of 15 feet. At site 5A.14, an area of 13 acres would be filled with material piled to a height of 25 feet. This site would permanently accommodate 407,500 cubic yards of dredge material from cut 4. A total of 773,500 cubic yards of material from cuts 5 and 6 would be placed at site 5A.23. Of this, 410,000 cubic yards would be removed for beneficial use, and 363,500 cubic yards would permanently remain on the site. An area of 18 acres would be filled with dredge material piled to a height of 15 feet. Material from cuts 2, 3, 4 and 6 would be placed at sites 5A.08, 5A.32, 5A.14 and 5A.23, respectively, by direct hydraulic methods. Material from cut 5 would be mechanically dredged and placed at site 5A.23.

Economic. This alternative has a total cost of $9,288,492 or $323,998 (3.6%) more than alternative C. Alternative E is more costly than alternative C due, in part, to the mechanical dredging of cut 5 in lieu of the direct hydraulic method used in alternative C.

Environmental. At sites 5A.32, 5A.23, 5A.14, and 5A.08, 17 acres of revegetating dredged material, 20 acres of bottomland hardwood, 1 acre of shallow marsh, and 1 acre to shallow aquatic habitat would be affected. Effluent discharges from sites 5A.14 and 5A.08 would occur during some hydraulic dredging events.

Cultural. No effect is expected.

Social. Creation of developable property for Fountain City is possible. There would be impacts (aesthetic, traffic, land values) on the residential area adjacent to site 5A.32.

Recreation. Adverse impacts on 1,100 feet of beach at sites 5A.14 and 5A.08 are possible. There would be potential for expansion of the private recreational facility at site 5A.23.

Hydraulic. No appreciable effect upon water surface profiles, velocities, and flow distribution is expected.

ALTERNATIVE F

Description. This alternative involves the use of sites 5A.08, 5A.32, 5A.25 and 5A.23. At site 5A.08, and area of 10 acres would be filled with material piled to a height of 25 feet. This site would permanently accomodate 276,000 cubic yards of dredge material from cut 2. A total of 488,500 cubic yards of material from cut 3 and a portion of cut 4 would be permanently placed at site 5A.32. An area of 22 acres would be filled with material piled to a height of 15 feet. The remaining 380,000 cubic yards of material from cut 4 would be placed at site 5A.25. Material placed at this 4-acre site would ultimately be removed by beneficial use. A total of 773,500 cubic yards of material from cuts 5 and 6 would be placed at site 5A.23. Of this, 410,000 cubic yards would be removed for beneficial use, and 363,500 cubic yards would permanently remain on the site. An area of 18 acres would be filled with dredge material piled to a height of 15 feet. Material from cuts 2,3 and 6 would be placed at sites 5A.08, 5A.32 and 5A.23, respectively, by direct hydraulic methods. A small portion of cut 4 (27,500 cy) would be mechanically dredged, unloaded at an inwater rehandling site and then hydraulically placed at site 5A.32. The larger remaining portion of cut 4 (380,000 cy) and cut 5 would be mechanically dredged and placed at sites 5A.25 and 5A.23, respectively.

Economic. This alternative has a total cost of $9,525,413 or $560,919 (6.2%) more than alternative C. Alternative F is more costly than alternative C due, in part, to the mechanical dredging of cuts 4 and 5 in lieu of the direct hydraulic method used in alternative C.

Environmental. At sites 5A.32, 5A.23, and 5A.08, 4 acres of revegetating dredged material, 26 acres of bottomland hardwood, 4 acres of shallow marsh and 10 acres of shallow aquatic habitat would be affected. Effluent discharges from site 5A.08 would occur during some hydraulic dredging events. Localized temporary increases in turbidity and suspended solids would occur during periods of in-water rehandling.

Cultural. No effect is expected.

Social. Creation of developable property for Fountain City is possible. There would be potential impacts (aesthetic, traffic, land values) on the residential area adjacent to site 5A.32.

Recreation. There would be potential for expansion of the private recreational facility at site 5A.23. Adverse impacts on 500 feet of beach at site 5A.08 are possible.

Hydraulic. No appreciable effect upon water surface profiles, velocities, and flow distribution is expected.

ALTERNATIVE G

Description. This alternative involves the use of sites 5A.32, 5A.14 and 5A.23 for the placement of dredged material from pool 5A. A total of 737,000 cubic yards of material from cuts 2 and 3 would be placed at site 5A.32. Of this, 380,000 cubic yards would be removed for beneficial use, and 357,000 cubic yards would permanently remain on the site. An area of 17 acres would be filled with dredge material piled to a height of 15 feet. A total of 771,000 cubic yards of material from cut 4 and a portion of cut 5 would be permanently placed at site 5A.14. An area of 25 acres would be filled with material piled to a height of 25 feet. A total of 410,000 cubic yards of material from the remaining portion of cut 5 and cut 6 would be placed at site 5A.23. Material placed at this 2-acre site would ultimately be removed by beneficial use. Site 5A.36 may be used in lieu of site 5A.23 as a beneficial use site. A portion of material from cut 5 (360,500 cy) would be mechanically dredged and placed at site 5A.23. Placement of all remaining cut material to the respective sites would be by direct hydraulic methods.

Economic. This alternative is the second least expensive alternative with a total cost of $8,996,267 or $31,773 (0.3%) more than alternative C. Alternative G is more costly than alternative C due, in part, to the mechanical dredging of cut 5 in lieu of the direct hydraulic method used in alternative C.

Environmental. At sites 5A.32, 5A.14, and 5A.23, 9 acres of bottomland hardwood, 3 acres of shallow marsh, 7 acres of shallow aquatic habitat and 25 acres of revegetating dredged material would be affected. Effluent discharges from site 5A.14 would occur during some hydraulic dredging events.

Cultural. No effect is expected.

Social. Creation of developable property for Fountain City is possible. There would be potential impacts (aesthetic, traffic, land values) on the residential area adjacent to site 5A.32.

Recreation. Adverse impacts on 1,100 feet of beach at site 5A.14 are possible.

Hydraulic. No appreciable effect upon water surface profiles, velocities, and flow distribution is expected.

ALTERNATIVE H

Description. This alternative involves the use of sites 5A.32, 5A.25, 5A.14 and 5A.23 for placement of dredged material from pool 5A. A total of 764,500 cubic yards of material from cut 2,3 and a portion of cut 4 would be permanently placed at site 5A.32. An area of 34 acres would be filled with dredge material piled to a height of 15 feet. The remaining 380,000 cubic yards of material from cut 4 would be placed at site 5A.25. Material placed at this 4-acre site would ultimately be removed by beneficial use. Approximately half of cut 5, 363,500 cubic yards of dredge material, would be permanently placed at site 5A.14. An area of 13 acres would be filled with dredge material piled to a height of 23 feet. A total of 410,000 cubic yards of material from the remaining portion of cut 5 and cut 6 would be placed at site 5A.23. Material placed at this 2-acre site would ultimately be removed by beneficial use. Site 5A.36 may be used in lieu of site 5A.23. as a beneficial use site. The portion of cut 4 to be placed at site 5A.32 would be mechanically dredged, unloaded at an in-water rehandling site and then hydraulically placed. The remaining portion of cut 4 and a portion of cut 5 would be mechanically dredged and placed at sites 5A.25 and 5A.23, respectively. Placement of all remaining cut material to the respective sites would be by direct hydraulic methods.

Economic. This alternative has a total cost of $9,206,644 or $242,150 (2.7%) more than alternative C. Alternative H is more costly than alternative C due, in part, to mechanical dredging of cut 4 and a portion of cut 5 in lieu of the direct hydraulic method used in alternative C.

Environmental. At sites 5A.32, 5A.14 and 5A.23, 10 acres of bottomland hardwood, 6 acres of shallow marsh, 20 acres of shallow aquatic habitat and 13 acres of revegatating dredged material would be affected. Localized temporary increases in turbidity and suspended solids would occur during periods of in-water rehandling.

Cultural. No effect is expected.

Social. Creation of developable property for Fountain City is possible. There would be potential impacts (aesthetic, traffic, land values) on the residential area adjacent to site 5A.32.

Recreation. Adverse impacts on 600 feet of beach at site 5A.14 are possible.

Hydraulic. No appreciable effect upon water surface profiles, velocities, and flow distribution is expected.

THALWEG DISPOSAL

Existing capability to predict sediment movement is not sufficient to allow the inclusion of thalweg disposal as a planning alternative at this time. If ongoing research and studies provide this capability in the future, the possibility of thalweg disposal for cuts 4 and 5 would be examined.

Table 4
Summary of Alternatives

Alt.	Cut	Site	Quantity Cut	Quantity Total	Beneficial Use Removal	Quantity On Site	Depth of Fill	Acres
A	2 3 4	5A.32	276,000 461,000 27,500	764,500	0	764,500	15'	34
	4	5A.25	380,000	380,000	380,000	0	Varies w/removal	4
	5 6	5A.23	724,000 49,500	773,500	410,000	363,500	15'	18
A1	2 3 4	5A.32	276,000 461,000 27,500	764,500	0	764,500	25'	22
	4	5A.25	380,000	380,000	380,000	0	Varies w/removal	4
	5 6	5A 23	724,000 49,500	773,500	410,000	363,500	25'	12
B	2 3	5A.32	276,000 461,000	737,000	380,000	357,000	15'	17
	4	5A.14	407,500	407,500	0	407,500	25'	13
	5 6	5A.23	724,000 49,500	773,500	410,000	363,500	15'	18
C	2 3	5A.32	276,000 461,000	737,000	380,000	357,000	15'	17
	4 5	5A.14	407,500 724,000	1,131,500	0	1,131,500	25'	36
	6	5A.23 (5A.36)	49,500	49,500	49,500	0	Varies w/removal	2
D	2	5A.08	276,000	276,000	0	276,000	25'	10
	3	5A.32	461,000	461,000	380,000	81,000	15'	4
	4 5	5A 14	407,500 724,000	1,131,500	0	1,131,500	25'	36
	6	5A.23 (5A.36)	49,500	49,500	49,500	0	Varies w/removal	2
E	2	5A.08	276,000	276,000	0	276,000	25'	10
	3	5A.32	461,000	461,000	380,000	81,000	15'	4
	4	5A.14	407,500	407,500	0	407,500	25'	13
	5 6	5A.23	724,000 49,500	773,500	410,000	363,500	15'	18
F	2	5A.08	276,000	276,000	0	276,000	25'	10
	3 4	5A.32	461,000 27,500	488,500	0	488,500	15'	22
	4	5A.25	380,000	380,000	380,000	0	Varies w/removal	4
	5 6	5A.23	724,000 49,500	773,500	410,000	363,500	15'	18
G	2 3	5A.32	276,000 461.000	737,000	380,000	357,000	15'	17
	4 5	5A.14	407,500 363,500	771,000	0	771,000	25'	25
	5 6	5A.23 (5A.36)	360,500 49,500	410,000	410,000	0	Varies w/removal	2
H	2 3 4	5A.32	276,000 461,000 27,500	764,500	0	764,500	15'	34
	4	5A.25	380,000	380,000	380,000	0	Varies	4
	5	5A.14	363,500	363,500	0	363,500	23'	13
	5 6	5A.23 (5A.36)	360,500 49,500	410,000	410,000	0	Varies w/removal	2

LEGEND: ( )Site 5A.36 could be used in lieu of 5A.23 as a beneficial use site only for materials placed from Cut 6 (49,500 cy) or 5 and 6 (410,000cy) when there is no permanent placement.

Table 5

Summary of Economic Costs and Habitat Losses

	ITEM	ALTERNATIVES								
		A	A1	B	C	D	E	F	G	H
Economic	Total Costs	$9,411,767	$9,503,807	$9,214,386	$8,964,494	$9,038,600	$9,288,492	$9,525,413	$8,996,267	$9,206,644
	Differences In Cost With/Alt.C.	447,273	539,313	249,892	-	74,106	323,998	560,919	31,773	242,150
	% Difference	5.0	6.0	2.8	-	0.8	3.6	6.2	0.3	2.7
	Avg. Unit Cost	4.91	4.96	4.80	4.67	4.71	4.84	4.97	4.69	4.80
	Order of Costs	7	8	5	1	3	6	9	2	4
Habitat	Habitat Losses	52 acres	34 acres	48 acres	55 acres	46 acres	39 acres	44 acres	44 acres	49 acres
	Ord r of Hab. Losses	7	1	5	8	4	2	3	3	6

* Differences in Cost and % Difference are compared to Alternative C.
** Costs are ranked in order from the least expensive to the most expensive.
*** Habitat Losses are ranked in order from least to highest.

POTENTIAL GEOTECHNICAL IMPACTS

The impacts of dredged material placement on underground utilities, groundwater, subsurface foundations and existing embankment structures were not considered necessary to distinguish viable alternative plans in the reconnaissance level investigation. However, the following discussion of potential geotechnical impacts relates to the kind of information that will be addressed prior to implementation.

It has been proposed that existing structures, such as road, railroad and dam embankments act as dredge disposal containment dikes or as containment boundaries on one or more sides. At a minimum, fill will be placed to the embankment top elevation, with the option of increasing the fill a number of feet above that elevation. The impacts of placing fill adjacent to existing embankments depends on many variables. For example, existing embankment materials range from pervious to impervious or some combination. If the existing embankments are pervious, they may become unstable if water is ponded and seepage occurs through the embankment. Calculations show that uncompacted sand slopes will be stable during seepage if they are 1V on 5H or flatter. In most instances, existing embankments are compacted with 1V on 2H to 1V on 3H side slopes. Calculations show that compacted embankments have increased stability but only slightly. On the other hand, if the existing embankments are impervious, ponded water will pass through the foundation under the embankment. If the head is great enough, piping could result, which could cause failure of the embankment. If the water is allowed to flow back into the river or surrounding area without ponding, seepage problems would be less likely, however, the additional weight of the fill on the structure foundation could cause an unstable structure or settlement of the structure. Embankments may experience differential settlements, or settlement which would require annual maintenance.

The construction of containment dikes near streams or rivers could cause unstable dike and/or river side slopes depending on foundation characteristics and the total height of the dike. In addition, there is the potential that abandoned gravel pits may be a source of groundwater recharge. Thus groundwater contamination could result from disposal at these sites.

MATRIX EVALUATION

The dredged material placement evaluation matrix (see Table 6) developed during the Upper Mississippi River Basin Commission study is used here, with some modifications, to compare alternatives. Although this matrix has recognized limitations, it is a useful tool for comparing different channel maintenance plan alternatives having multi-faceted impacts. The evaluation criteria used in assigning values to the matrix are discussed in Appendix D.

TABLE 6
DREDGED MATERIAL PLACEMENT EVALUATION MATRIX

ALTERNATIVE	ECONOMIC: Site Availability R x 6 = S	ECONOMIC: Dredging Costs R x 15 = S	ECONOMIC: Benefits R x 9 = S	ENVIRONMENTAL: Water Quality R x 8 = S	ENVIRONMENTAL: Aquatic/Terr. Ecosystem R x 22 = S	CULTURAL: Cultural Resources R x 5 = S	SOCIAL: Recreation R x 5 = S	SOCIAL: Visual Impacts R x 1 = S	SOCIAL: Social Impacts R x 4 = S	TOTAL
A	-1.75 / -10.5	-0.75 / -11.25	2.5 / 22.5	0 / 0	-2.25 / -49.5	0 / 0	-0.7 / -3.5	-1.4 / -1.4	-0.7 / -2.8	-56.45
A1	-1.75 / -10.5	-1.0 / -15.0	2.5 / 22.5	0 / 0	-1.5 / -33.0	0 / 0	-0.7 / -3.5	-1.4 / -1.4	-0.7 / -2.8	-43.7
B	-3.0 / -18.0	-0.5 / -7.5	1.5 / 13.5	0 / 0	-2.0 / -44.0	0 / 0	-1.4 / -7.0	-1.7 / -1.7	-0.7 / -2.8	-67.5
C	-3.0 / -18.0	0 / 0	0.5 / 4.5	0 / 0	-2.13 / -46.86	0 / 0	-1.4 / [illegible]	-1.8 / -1.8	-0.7 / -2.8	[illegible]
D	-3.0 / -18.0	-0.25 / -3.75	0 / 0	-0.5 / -4.0	-1.63 / -35.86	0 / 0	-1.4 / [illegible]	-1.8 / -1.8	-0.9 / -3.6	[illegible].01
E	-3.0 / -18.0	-0.75 / -11.25	1.0 / 9.0	-0.5 / -4.0	-1.5 / -33.0	0 / 0	[illegible] / [illegible]	-1.7 / -1.7	-0.5 / -2.0	[illegible]
F	-1.75 / -10.5	-1.0 / -15.0	1.75 / 13.5	-0.5 / -4.0	-1.75 / -38.5	0 / 0	-0.9 / -4.5	-1.5 / -1.5	-0.9 / -3.6	[illegible]
G	-3.0 / -18.0	-0.25 / -3.75	1.75 / 15.75	-0.5 / -4.0	-1.88 / -41.36	0 / 0	-1.4 / -7.0	-1.8 / -1.8	-0.7 / -2.8	-64.46
H	-3.0 / -18.0	-0.5 / -7.5	2.25 / 20.25	-0.5 / -4.0	-2.13 / -46.86	0 / 0	-1.2 / -6.0	-1.5 / -1.5	-0.9 / -3.6	-67.21

DISCUSSION

Total matrix evaluation scores indicate that alternative A1 is the best overall dredged material placement plan. Further analysis of the matrix reveals that, overall, site availability was the most important values favoring alternatives A and A1. Recreation impacts were also generally lower for alternatives A and A1, although their relative value in the matrix is substantially less than econonic and environmental considerations. Aesthetic and social impacts were relatively comparable among all alternatives. No known cultural resources would be affected in this pool. Environmental impacts associated with the terrestrial and aquatic ecosystem were the single most important value favoring alternative A1 over A (the GREAT recommendation).

RECOMMENDED DREDGED MATERIAL PLACEMENT PLAN

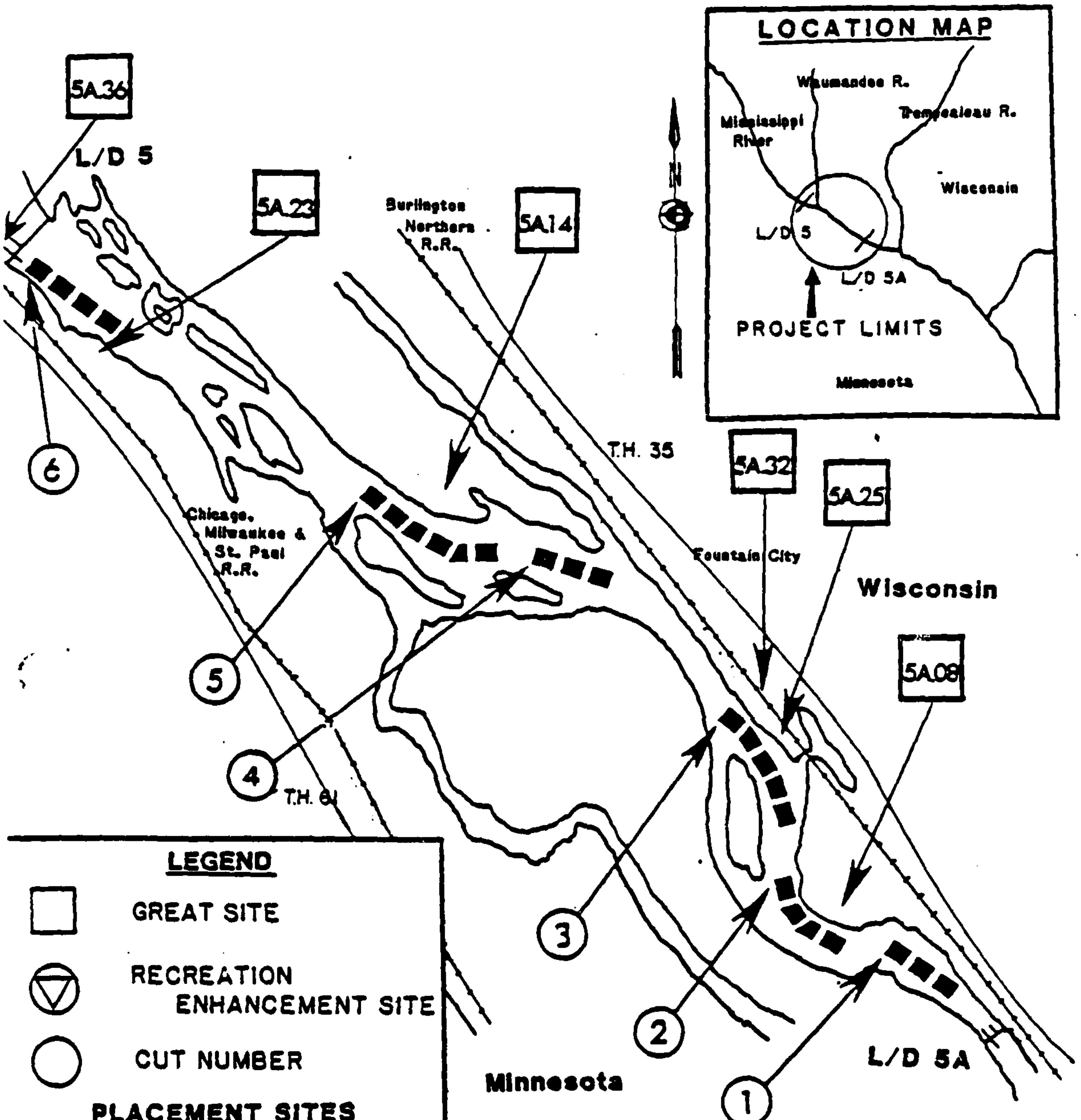
The following recommended plan for dredged material placement in pool 5A is based upon survey information of anticipated beneficial use and historic dredge cut depths, modified by estimates of Most Probable Future with GREAT (MPFWG) conditions. The plan is intended as a guide for managing the St. Paul District's channel maintenance program, which establishes dredged material placement sites for use over the next 40 years. As additional information becomes known (e.g., actual beneficial use, secondary movement) changes will be made to the plan.

PROPOSAL AND RATIONALE

The proposed plan for dredged material placement in pool 5A is alternative A1, as described in this report. Alternative A1 is basically a "high pile" version of alternative A (the GREAT recommendation). The environmental impacts of this alternative are less than those of the GREAT recommendation or any of the other alternatives. Implementation of this alternative will cost $539,313 more than the least expensive alternative, and $92,040 more than the GREAT recommendation. None of the three sites that would be used in alternative A1 are owned by the Federal government. Government acquisition is anticipated for only one site, and that site is relatively small at 4 acres. Owners of the remaining two sites are interested in receiving dredged material. However, material placed to the depths identified in this plan may render the site undevelopable or substantially more expensive to develop in the future. The social impacts of alternative A1 are equal to those of the GREAT recommendation, but less than those of any other alternatives. A simulated portrayal of aesthetic (visual resource) impacts associated with dredged material placed at site 5A.32 gave a preliminary indication that proper placement of evergreen and deciduous plant material would mitigate these impacts. Mitigation of visual impacts with plant material and control of secondary erosion with riprap, vegetative cover, and grading would be part of the St. Paul District's operating plan. Control of and access to any dredged material placement site by the Federal government will be a part of all real estate transactions.

IMPLEMENTATION SCHEDULE

After the review and approval process for this report is complete, the Corps will immediately begin to implement the recommended plan. Appropriate State and Federal permits will be requested. Formal permission will be obtained from the landowners involved, or if necessary, site acquisition measures will begin. The recommended placement sites will initially be prepared and used within existing equipment capability and funding allocations. Specific funds for implementing the plan will be requested in the next formal budget submittal. Equipment improvements and modifications will be scheduled through the normal Plant Replacement and Improvement Program (PRIP). If necessary, existing equipment will be supplemented by contract as funding allows.



LEGEND

GREAT SITE

RECREATION ENHANCEMENT SITE

CUT NUMBER

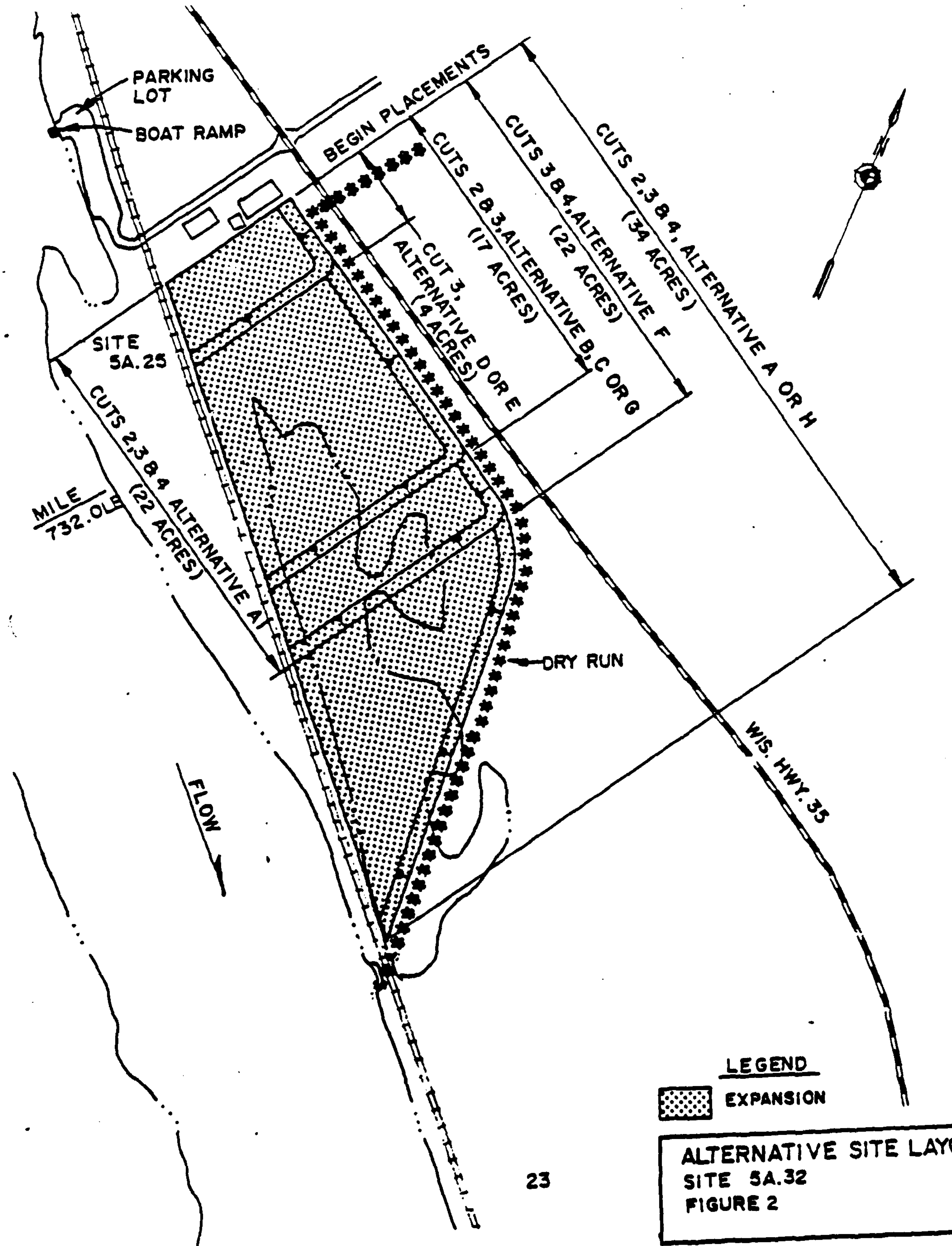
PLACEMENT SITES

Number	Site Name	River Mile
5A.08	WILD'S BEND	730.5
5A.25	GOTZ	732.0
5A.32	FOUNTAIN CITY	732.0
.14	ISLAND NO. 58	734.5
5A.23	BASS CAMP	737.5
5A.36	LOCK & DAM 5	738.1

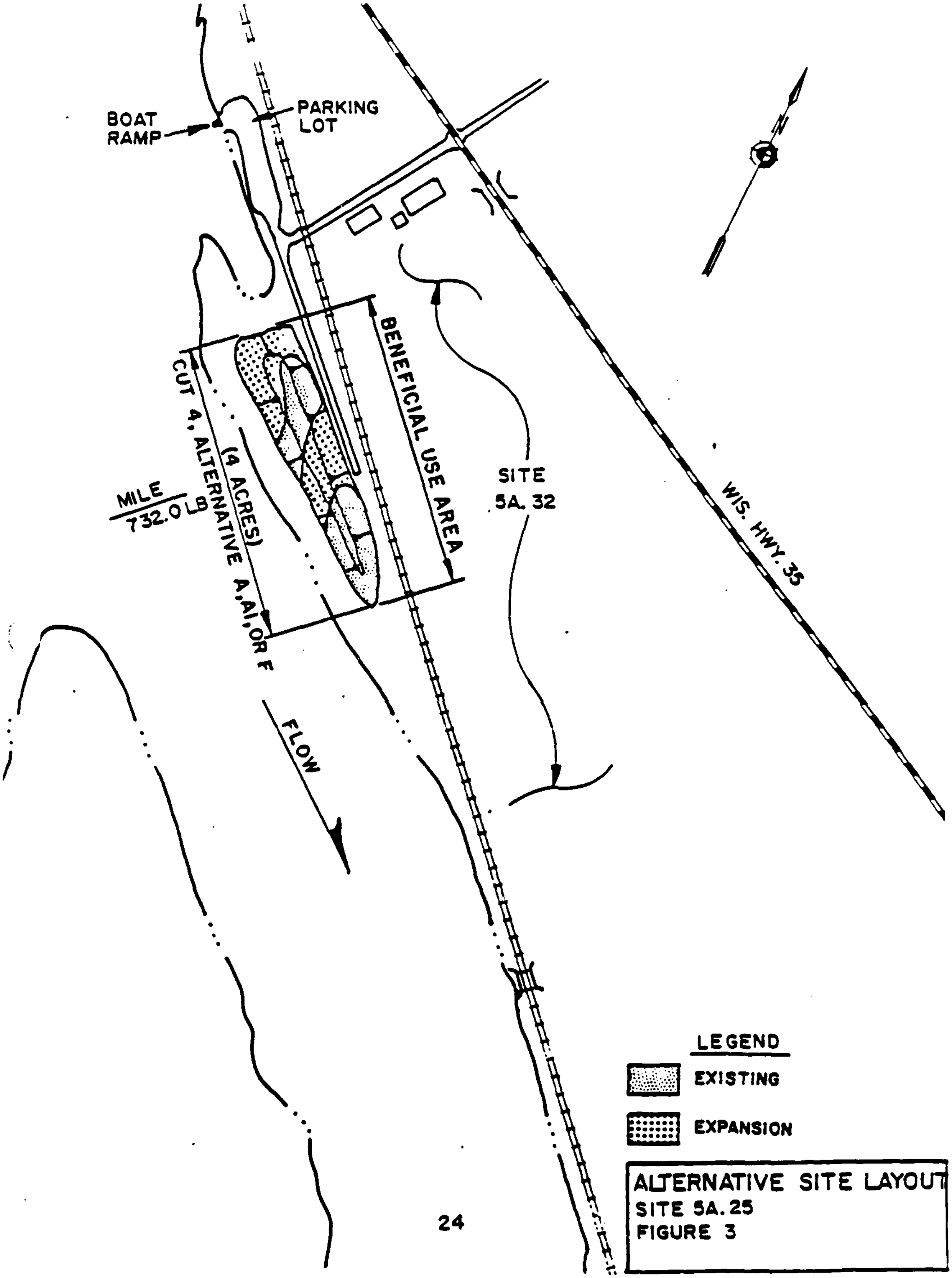
GREAT I IMPLEMENTATION
FOR
POOL 5A

VICINITY AND LOCATION MAP
FOR
DREDGED MATERIAL PLACEMENT

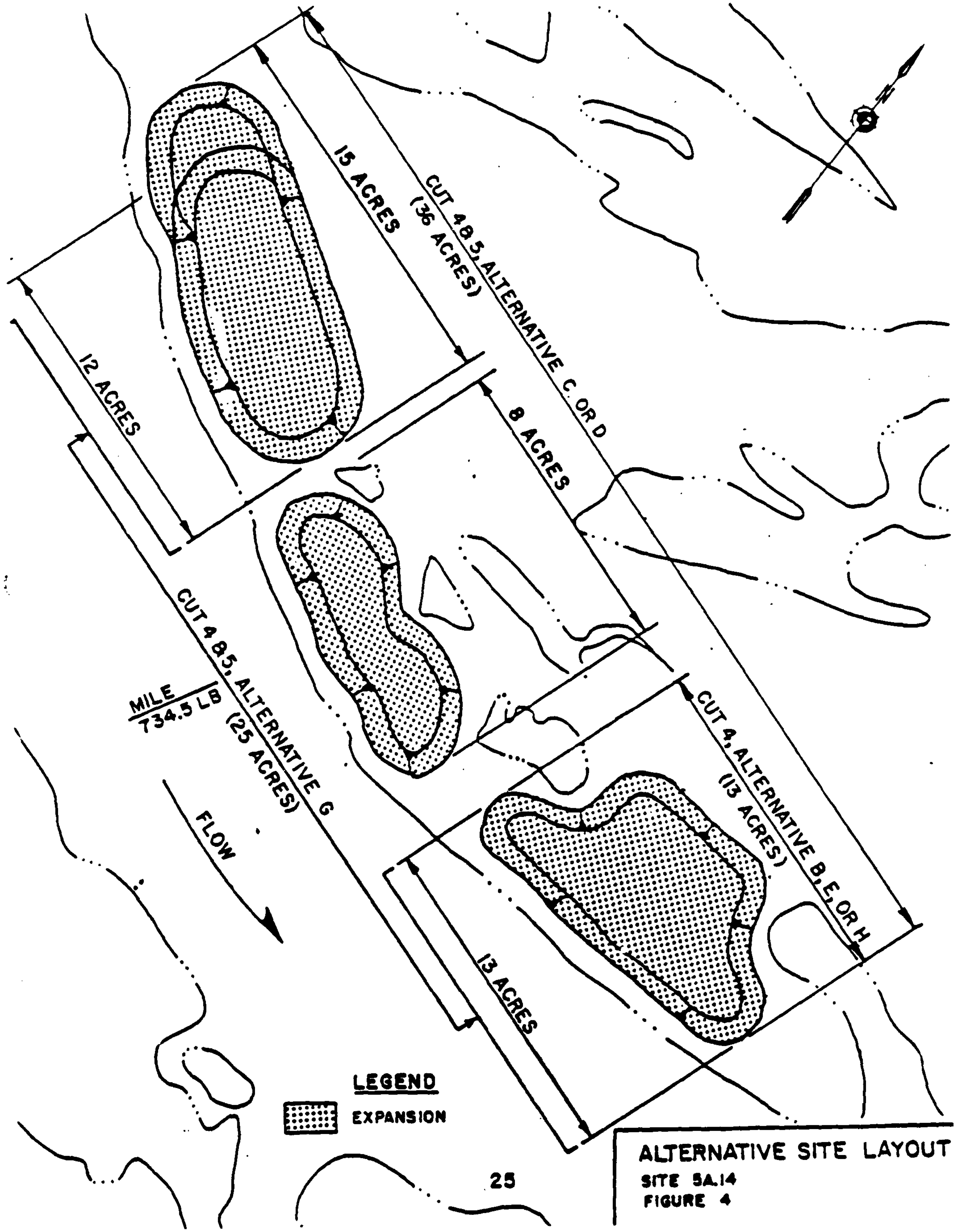
FIGURE 1



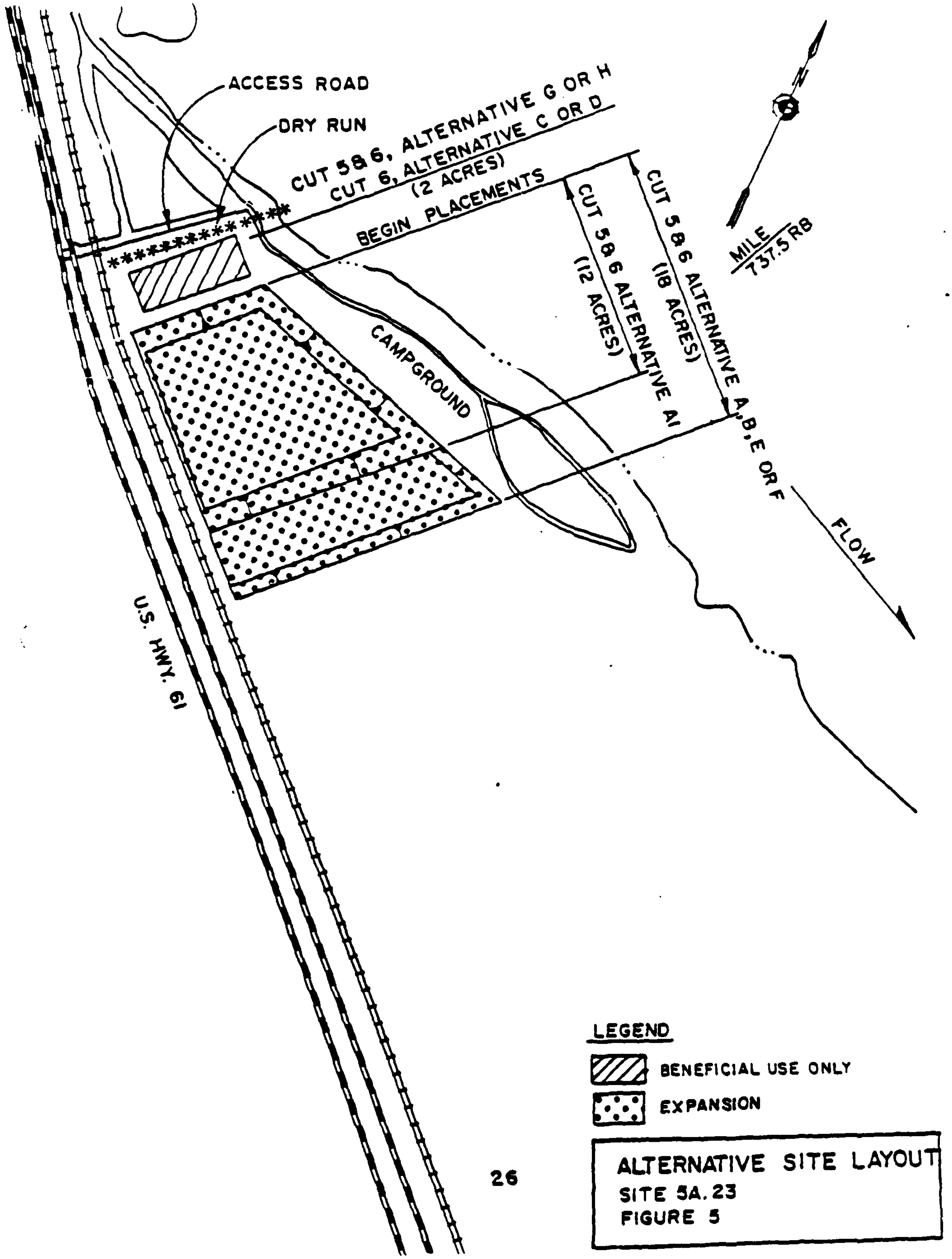
ALTERNATIVE SITE LAYOUT
SITE 5A.32
FIGURE 2



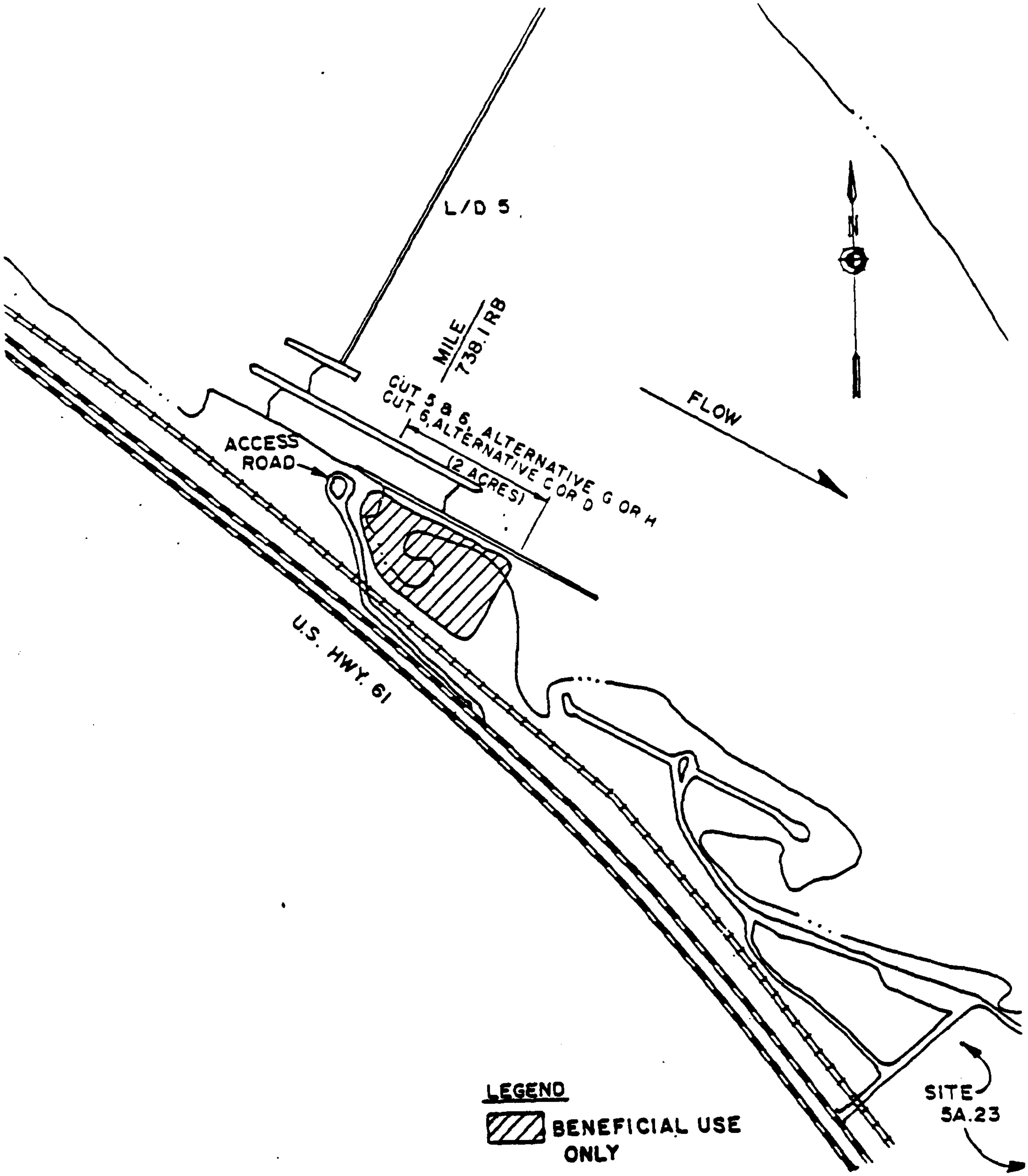
ALTERNATIVE SITE LAYOUT
SITE 5A. 25
FIGURE 3



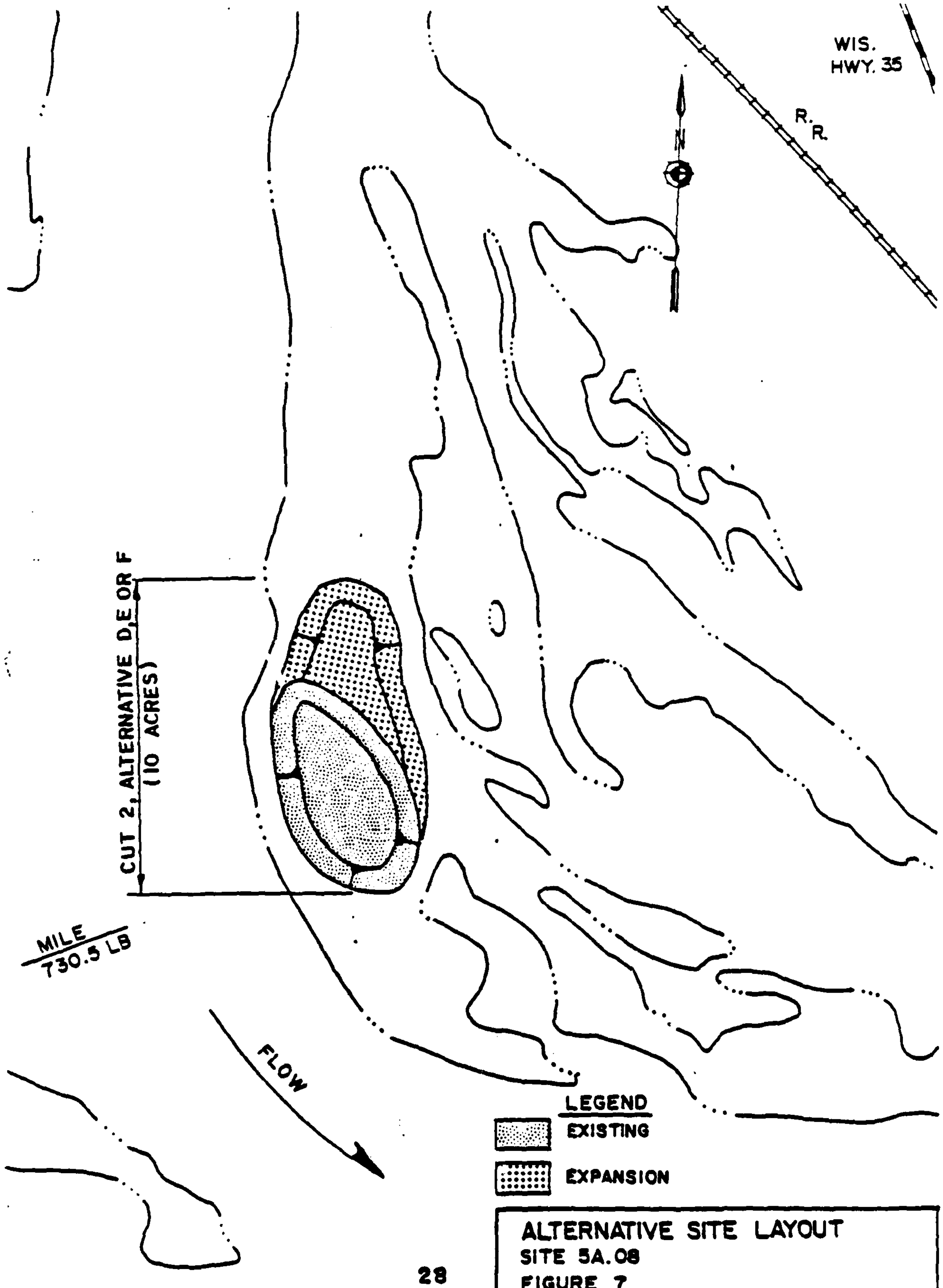
ALTERNATIVE SITE LAYOUT
SITE 5A.14
FIGURE 4



ALTERNATIVE SITE LAYOUT
SITE 5A. 23
FIGURE 5



ALTERNATIVE SITE LAYOUT
SITE 5A. 36
FIGURE 6



ALTERNATIVE SITE LAYOUT
SITE 5A.08
FIGURE 7

PART III

DREDGED MATERIAL DISPOSAL

There is no disposal of dredged material in connection with the proposed Iowa Vane installation.

APPENDIX H

NAVIGATION ANALYSIS

APPENDIX H
NAVIGATION ANALYSIS

Lock and Dam 5A Outdraft Analysis (30 April 1986)

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO

REFERENCE OR OFFICE SYMBOL	SUBJECT		
NCSPD-ES	LD 5A Outdraft Priority in FY 88 Budget		
TO	FROM	DATE	CMT 1
To: NCSED NCSCO	NCSPD	30 April 1986 RASTER/jo/7578	

1. Reference:

a. O & M FY88 Preliminary Budget prepared by Engineering Division, 15 April 1986; specifically, FY87 Sheet No. 353/FY88 Sheet No. 505 item--LD 3, 5A outdraft dike/guard wall.

b. Reconnaissance Report, Major Rehabilitation, Lock and Dam Numbers 5A, 6, 7, 8, & 9, Mississippi River, Minnesota & Wisconsin, March 1985.

c. Inventory of Potential Structural and Non-Structural Alternatives for Increasing Navigation Capacity--Upper Mississippi River System Master Plan, April 1981, by Louis Berger & Associates, Inc.

2. Summary:

a. Analyses of accident records conducted in conjunction with the LD 3 EIS provide an overview of the problems at the District's thirteen locks and dams.

b. These analyses show that the current high priority for a solution to the LD 5A outdraft condition may be unwarranted and that priority might better be directed to more serious trouble spots, such as LD 9.

3. The Problem:

a. Reference 1.b. notes that "... outdraft ... conditions for downbound tows approaching the lock are difficult, particularly during high flows.... Constructing a guard wall or rock dike in the river would greatly reduce this navigation hazard."

b. Reference 1.c. discusses the outdraft problems just upstream of LD 5A in terms of impact on approach times--a clear implication that outdraft effects on downbound tows are the primary concern.

c. According to lock personnel, the outdraft also poses a problem for upbound tows. When the first (unpowered) cut of a double is pulled out, the outdraft current tends to push the bow away from the guidewall. In 1962, barges were drawn into the dam under these circumstances. This problem has been largely solved, however, by a second traveling mooring bit. In fact, only two upbound accidents were recorded in the last 20 years, and those incidents were not a result of outdraft conditions. Therefore, the PD-ES analyses focused on downbound incidents.

4. Supporting Data:

a. For the LD 3 EIS, PD-ES analyzed accident records involving commercial tows at all the District locks and dams. Analyses included accident types, causes, and resulting damages to Corps facilities.

b. Downbound approach/entry accidents were identified; i.e., the type of incident most likely to be associated with/caused by/exacerbated by outdraft conditions. Based on the statement of the problem in reference 1.b., these same analyses were considered appropriate for ranking the relative seriousness of outdraft-related incidents at LD 5A.

c. Records for the 20-year period 1966-85 show 14 downbound approach/entry accidents at LD 5A, but none specifically mention outdraft as a cause. Alignment (which may be outdraft-related) is cited in 11 cases, speed in one case, and other factors in three cases. (The total exceeds 14 because an incident may have more than one contributing factor.) Figure 1 shows that causes of accidents at LD 5A essentially mirror causes at all the District's locks and dams. Alignment problems are cited frequently at many locks and dams, including those that do not have an outdraft reputation.

d. Table 1 and figure 2 show that the 14 accidents at LD 5A represent one of the better records in the District. Only LSAF, USAF, and LD 1 have substantially fewer incidents, and several locks and dams (3, 4, 5, 6, 9, and 10) have two or three times as many accidents.

Table 1: Downbound Approach/Entry Accidents (1966-85)

LOCK & DAM	ACCIDENTS	RANK
USAF	1	13
LSAF	3	12
1	7	11
2	13	10
3	42	1
4	39	2
5	27	5
5A	14	9
6	29	4
7	20	8
8	22	7
9	27	5
10	32	3
Average	13.8	--

e. Table 2 and figure 3 show that, in terms of average damages/incident and average damages/year, LD 5A ranks in the middle of the District's locks and dams. LD 5A damages are substantially below the District averages and are a fraction of those at LD 3, 5, and 9, in particular.

Table 2: Downbound Approach/Entry Accident Damages (1966-85)

Lock & Dam	Average Damages Per Incident	Rank	Average Damages Per ~~Incident~~ yr.	Rank
USAF	$ 509	13	$ 25	13
LSAF	1,474	9	221	12
1	634	12	222	11
2	1,443	10	938	10
3	7,199	3	15,118	3
4	3,906	6	7,617	5
5	11,444	2	15,450	2
5A	4,223	5	2,956	6
6	1,778	8	2,578	7
7	2,214	7	2,214	8
8	1,433	11	1,576	9
9	23,939	1	32,317	1
10	5,010	4	8,016	4
Average	6,467	--	6,865	--

f. Assist boat service to help prevent alignment problems has been available at LD 5A for over 20 years. Currently, this service is provided by Harbor Service of Winona. This service is voluntary; if a commercial tow wants the service, the tow calls ahead on marine radio to arrange for a harbor tug to meet the tow at LD 5A. (If requested, PD-ES will analyze recent PMS data to determine the extent and conditions under which assist boat service is used at LD 5A.)

g. In the last 24 years, only one into-the-dam incident occurred at LD 5A (see 3.c. above) compared to eight at LD 3. LD 5A's incident resulted in no damage to Corps facilities.

5. Conclusions and Recommendations:

a. Despite its reputation, LD 5A does not have a poor accident record.

b. Apparently, its outdraft reputation may be generating sufficient respect that pilots are especially attentive in their approach to the lock. Furthermore, assist boat service is available if the outdraft is particularly bad. (This service probably contributes to the relatively good record at LD 5A; if requested, PD-ES could conduct analyses to quantify the service's impacts.)

c. Tables 1-2 and figures 1-3 suggest that priority be diverted to analyzing and solving accident-factors at locks and dams other than LD 5A. Candidates include:

(1) LD 4: Over the last 20 years, LD 4 has had the highest number of accidents (excepting LD 3), nearly three times the number at LD 5A.

(2) LD 9: LD 9 has almost twice as many accidents as LD 5A. Furthermore, the LD 9 average damages/year are more than 10 times those at LD 5A, and the LD 9 *damages/incident* (a measure of the relative seriousness of the accidents at a lock) are over five times those at LD 5A.

(3) LD 5: LD 5 also has almost twice as many accidents as LD 5A and is second only to LD 9 in average damages/year (which is over five times the damages at LD 5A) and average damages/incident (which is almost three times the damages at LD 5A).

Louis Kowalski

LOUIS KOWALSKI
Chief, Planning Division

3 Encl
1. Figure 1
2. Figure 2
3. Figure 3

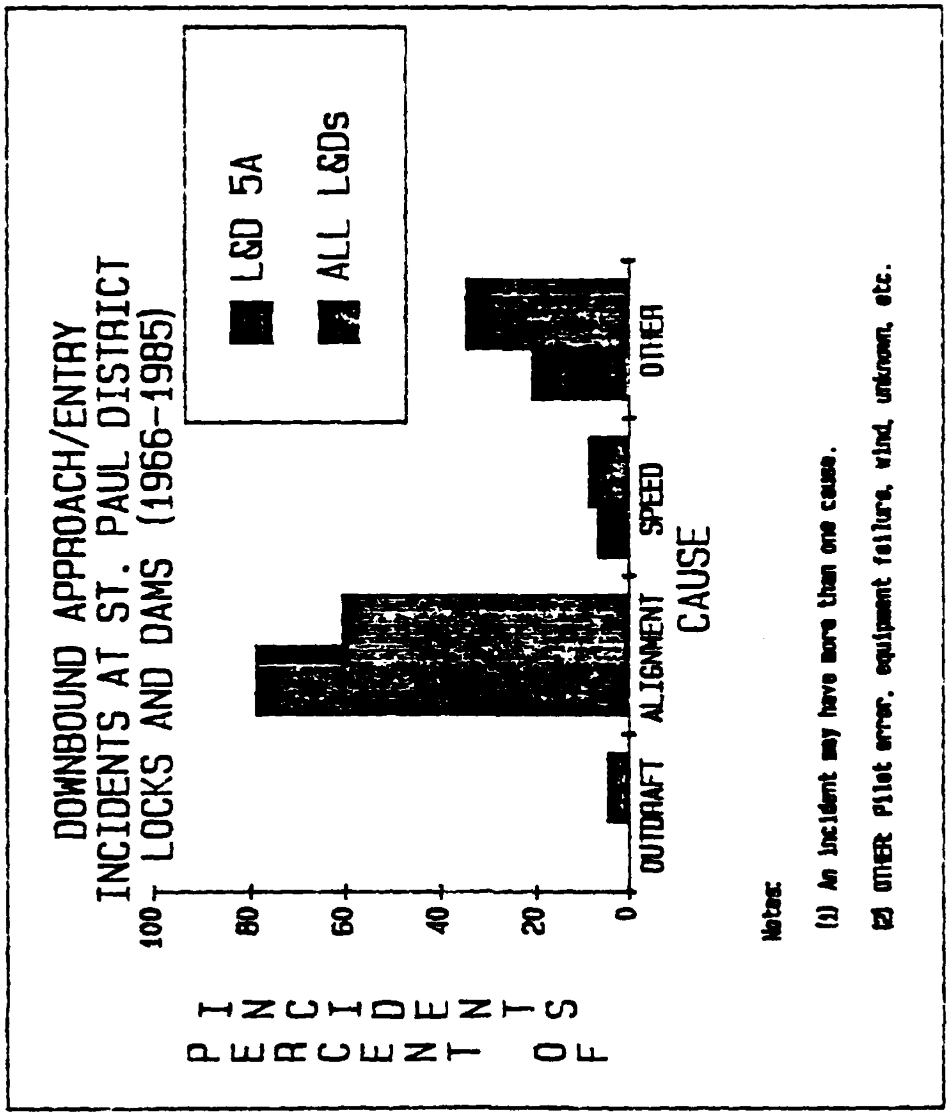
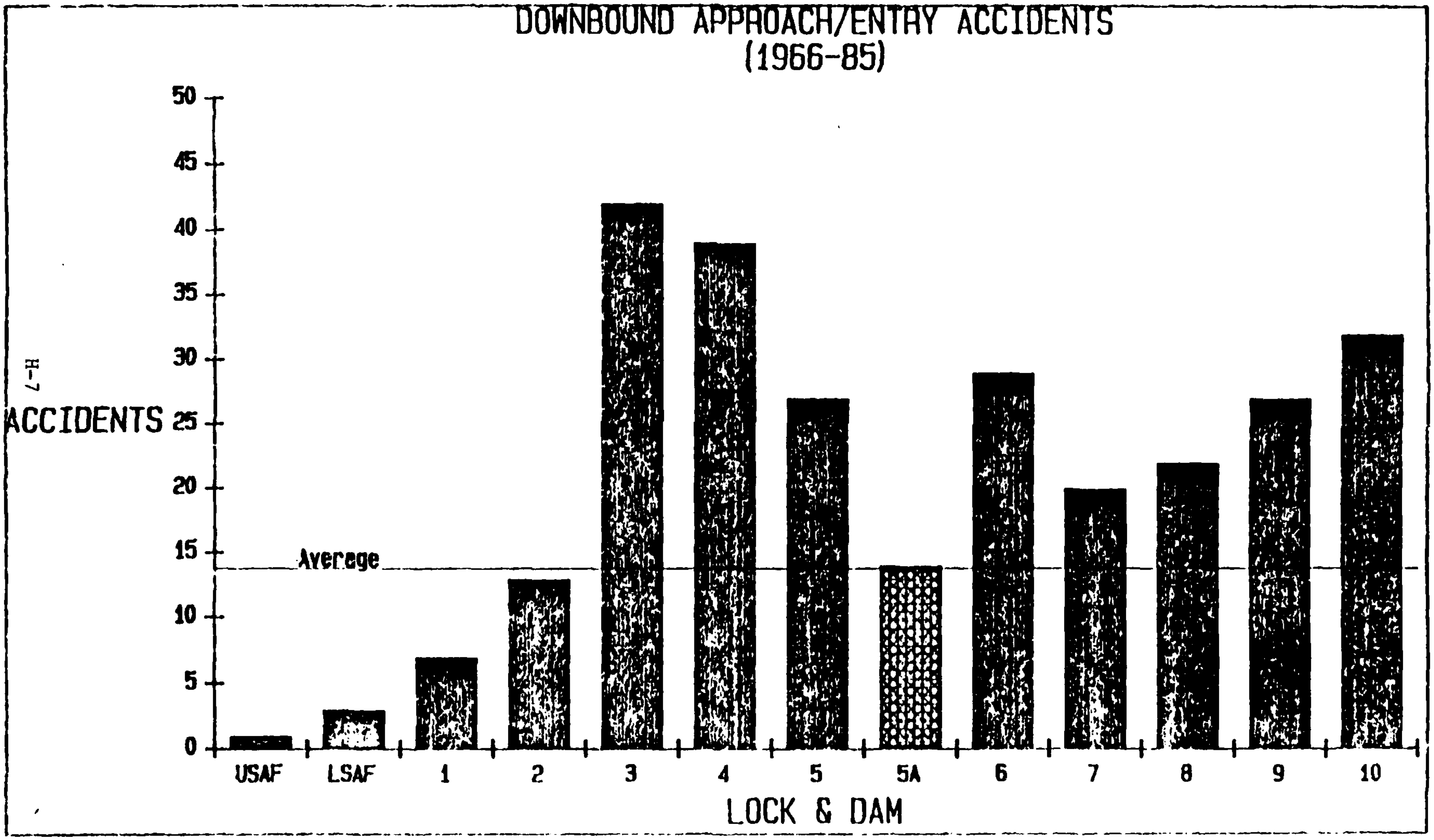

DOWNBOUND APPROACH/ENTRY
INCIDENTS AT ST. PAUL DISTRICT
LOCKS AND DAMS (1966-1985)
L&D 5A
ALL L&Ds
PERCENT OF INCIDENTS
100
80
60
40
20
0
OUTDRAFT
ALIGNMENT
SPEED
OTHER
CAUSE
Notes:
(1) An incident may have more than one cause.
(2) OTHER: Pilot error, equipment failure, wind, unknown, etc.

Figure 1


DOWNBOUND APPROACH/ENTRY ACCIDENTS
(1966-85)
ACCIDENTS
50
45
40
35
30
25
20
15
10
5
0
Average
USAF
LSAF
1
2
3
4
5
5A
6
7
8
9
10
LOCK & DAM

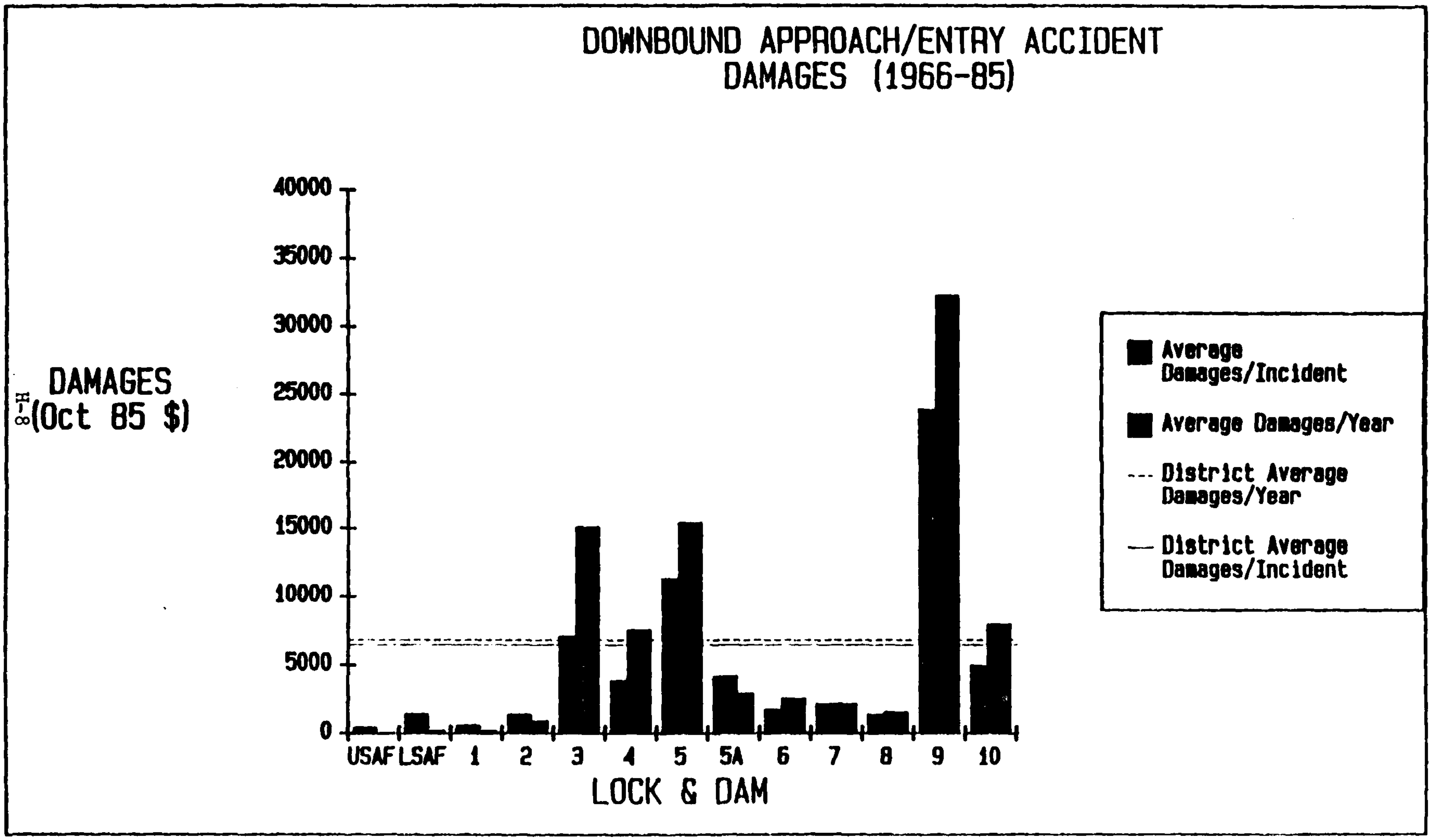

DOWNBOUND APPROACH/ENTRY ACCIDENT
DAMAGES (1966-85)
DAMAGES
(Oct 85 $)
40000
35000
30000
25000
20000
15000
10000
5000
0
USAF
LSAF
1
2
3
4
5
5A
6
7
8
9
10
LOCK & DAM
Average Damages/Incident
Average Damages/Year
District Average Damages/Year
District Average Damages/Incident

Figure 1